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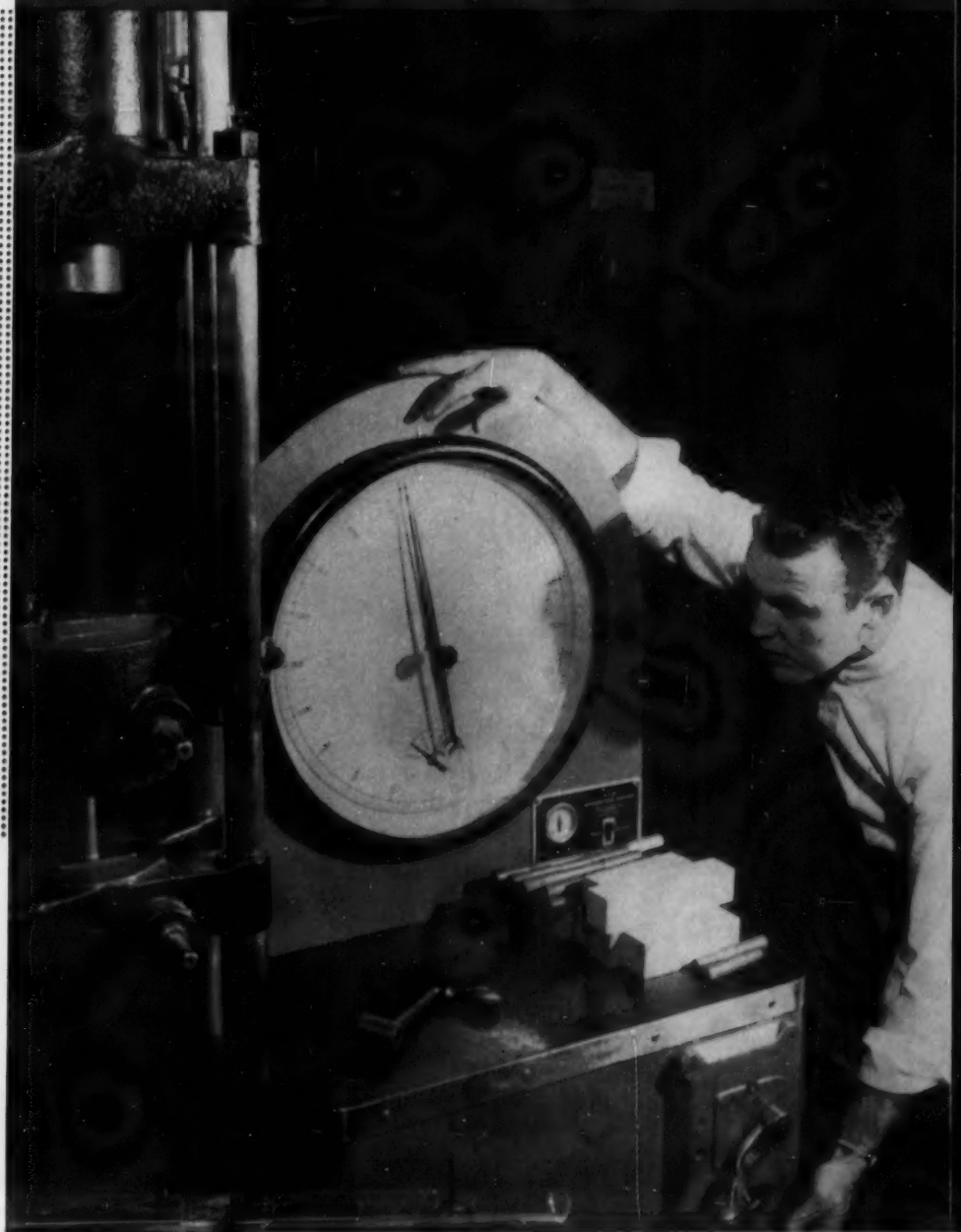

APRIL, 1956
VOL. 21, NO. 7
25 CENTS

Robert T. Blake, Class of '49

speaks from experience when he says,

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Bob Blake had his first experience in steel mills working there during summer vacations from college. After receiving his B.S. degree in Electrical Engineering, he became an operating trainee in U.S. Steel's Irvin Works. During his training program, his background and versatility were used by the Training Division to develop a training program for Electrical Maintenance employees. By the end of 1951, Mr. Blake had become a Foreman with experience in both Cold Reduction Maintenance and the Galvanizing Department.

Effort is made to have young engineers obtain varied experience before devoting themselves to one field. Mr. Blake feels that, "An engineering graduate has practically no ceiling provided he has the right attitude and is willing."

Promoted again in 1954, Mr. Blake is now Foreman—Electric Shop in Central Maintenance. Supervising a crew of 40 men, he is responsible for electrical construction work, maintenance and crane wiring. Mr. Blake feels he is in "an interesting and challenging field of work." He has found that "U.S. Steel is a highly desirable employer in this most basic of all industries."

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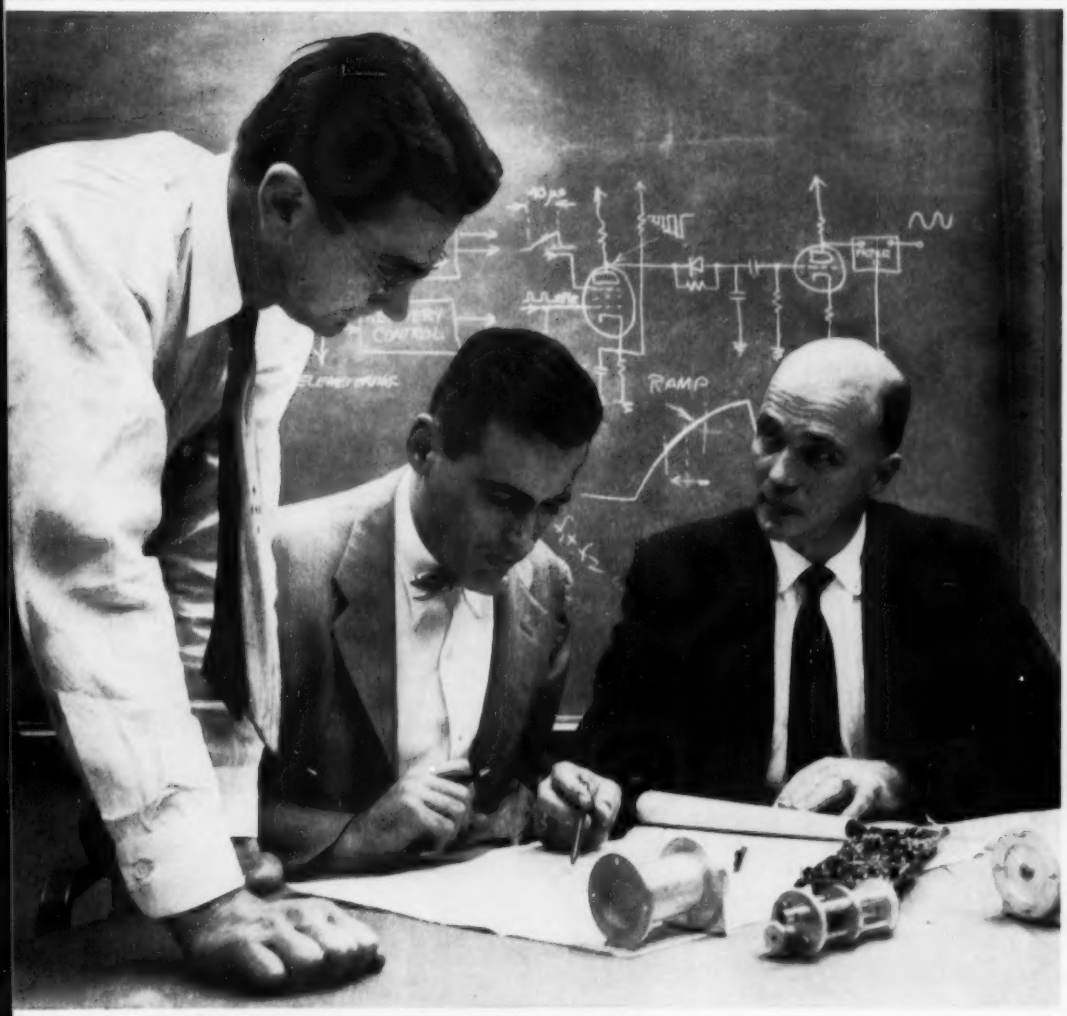
SCIENCE AND ENGINEERING

AT LOCKHEED MISSILE SYSTEMS DIVISION



Charles W. Goedecke, Electronic Design Group Engineer, Emerson M. Hoyt, Electronic Research Specialist, and George L. Larse, head of Electronic Systems Development in the Flight Test Electronics Department, discuss important aspects of new electronic command decoding devices for missile guidance systems.

MISSILE ELECTRONICS

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The advancement of missile systems technology can be measured to a great extent by increasing demands imposed on the ability of electronic systems and components engineers.

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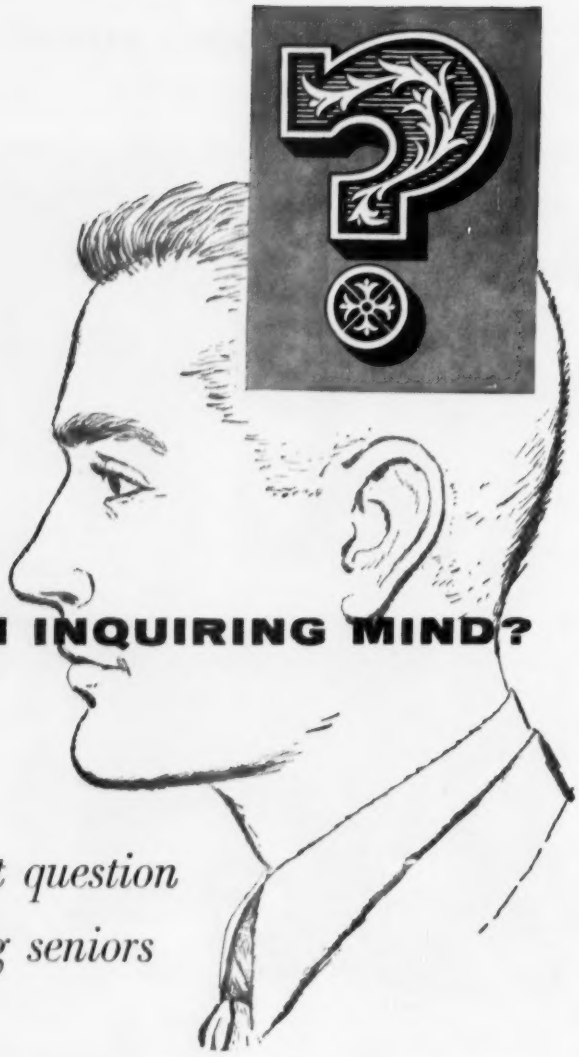

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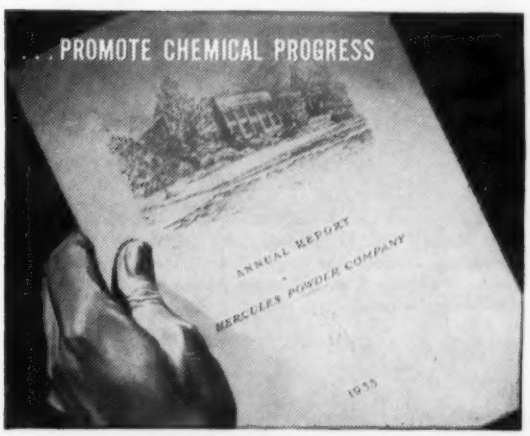

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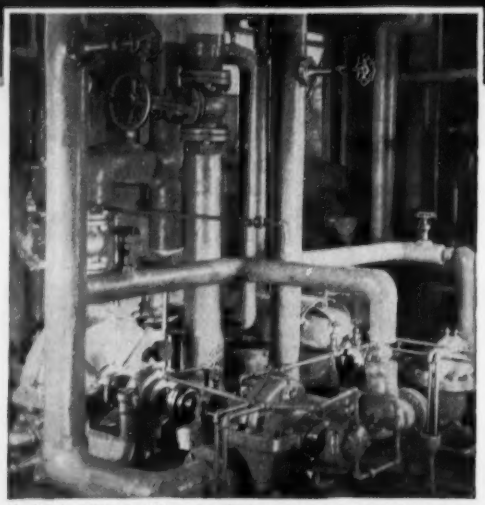

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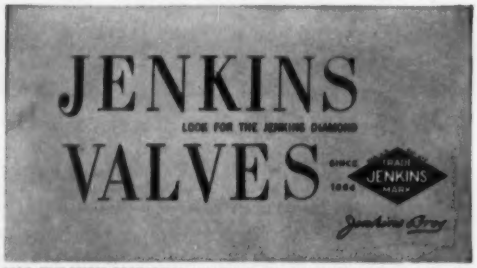

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An Open Letter on Engineer's Day

from the

Engineering Student Council

(See E-Day Article on Pages 19-21)

To the readers of the
Cornell Engineer:

Once again this year, on the 4th of May, the Engineering Student Council will sponsor our annual Engineers Day, a time during which the doors of the five schools of the College of Engineering are thrown open to welcome inspection by all who are interested in the technical pursuits of Cornell engineers. This event always affords an unparalleled opportunity for students, townspeople, and guests from several states to observe, under ideal conditions, students at work, demonstrating their skills at operating the multitude of equipment that is available to the Cornell engineer. As well as watching remarkable demonstrations of standard engineering apparatus and processes, the visitors to "E-Day" can see extraordinary exhibits of special student projects, school research work, and invited industrial displays.

Yearly, thousands benefit from Engineers Day—both the engineering students and faculty, who see the culmination of their planning, and our visitors, who, we are sure, gain a firmer appreciation for the intimate relation of the technical sciences to the larger community. Indeed, the Engineering Student Council firmly believes that any individual, no matter what his background, can not fail to be impressed, not only by the complex machines, roaring furnaces, and whirring gadgets, but also by the immensity and diversity of the vital contributions that engineering is making, at an accelerating rate, to countless areas of human endeavor. The Council also hopes that visitors will find the evidence of an intangible asset that the Cornell engineer has traditionally included as part of his college experience—the belief in inevitable technological progress, and the sincere desire to be a leader in that advance.

It was not by chance that May 4 was selected, because "E-Day" is traditionally one of the highlights of Sub-Frosh Weekend. It affords a marvelous opportunity for thousands of high school students to learn something of the engineering activities and educational program into which they or their contemporaries will enter. We hope that such contact with college technology will continue to be a decisive influence in heightening the interest of many prospective Cornell engineers.

This year's "E-Day" promises the most eventful and well-rounded program in its history, including first-time participation by the Agricultural Engineers. And so, for the entire College of Engineering, we invite the Cornell community and alumni, the public, and especially the Sub-Frosh to attend this annual exhibition.

The Engineering Student Council

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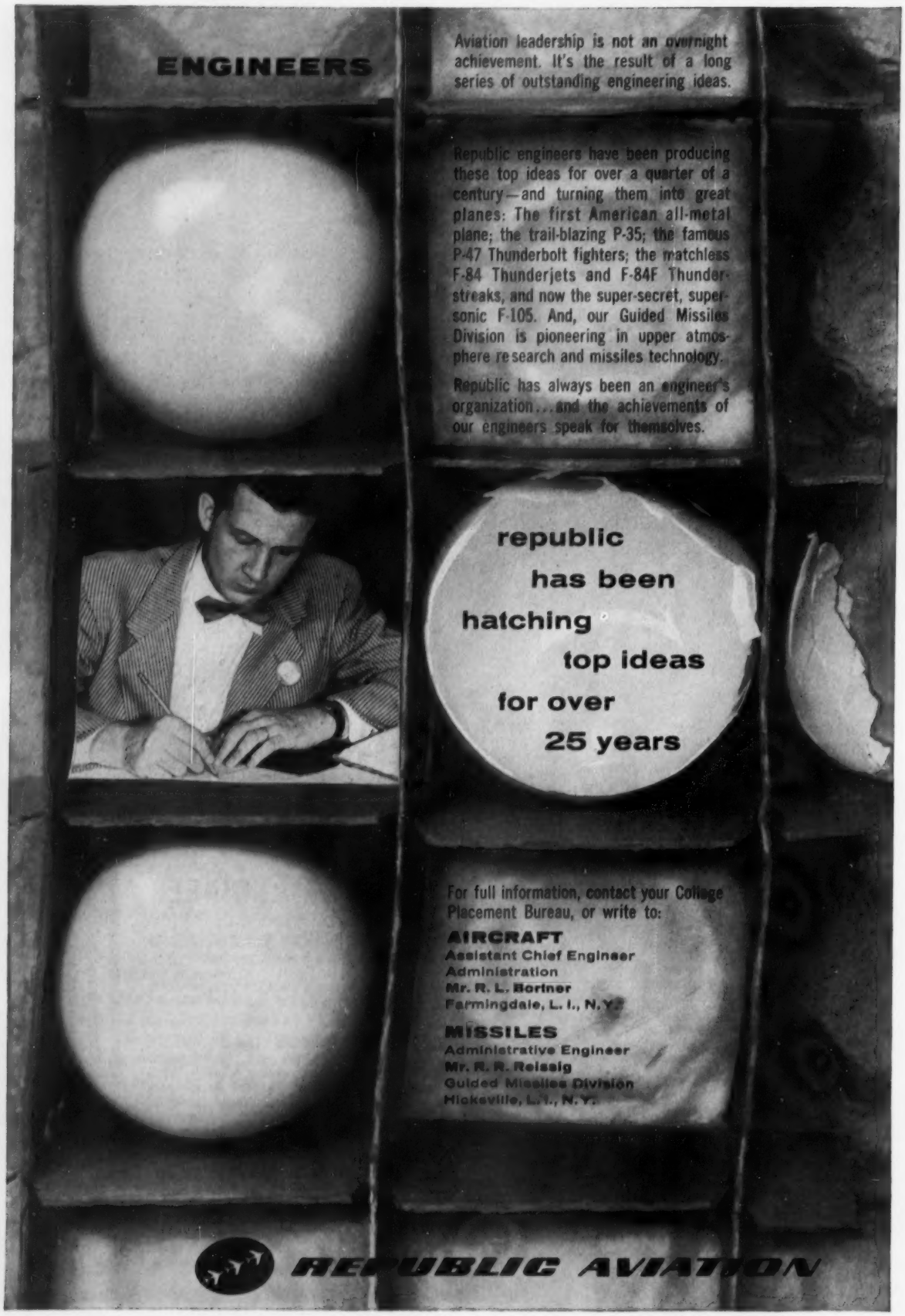
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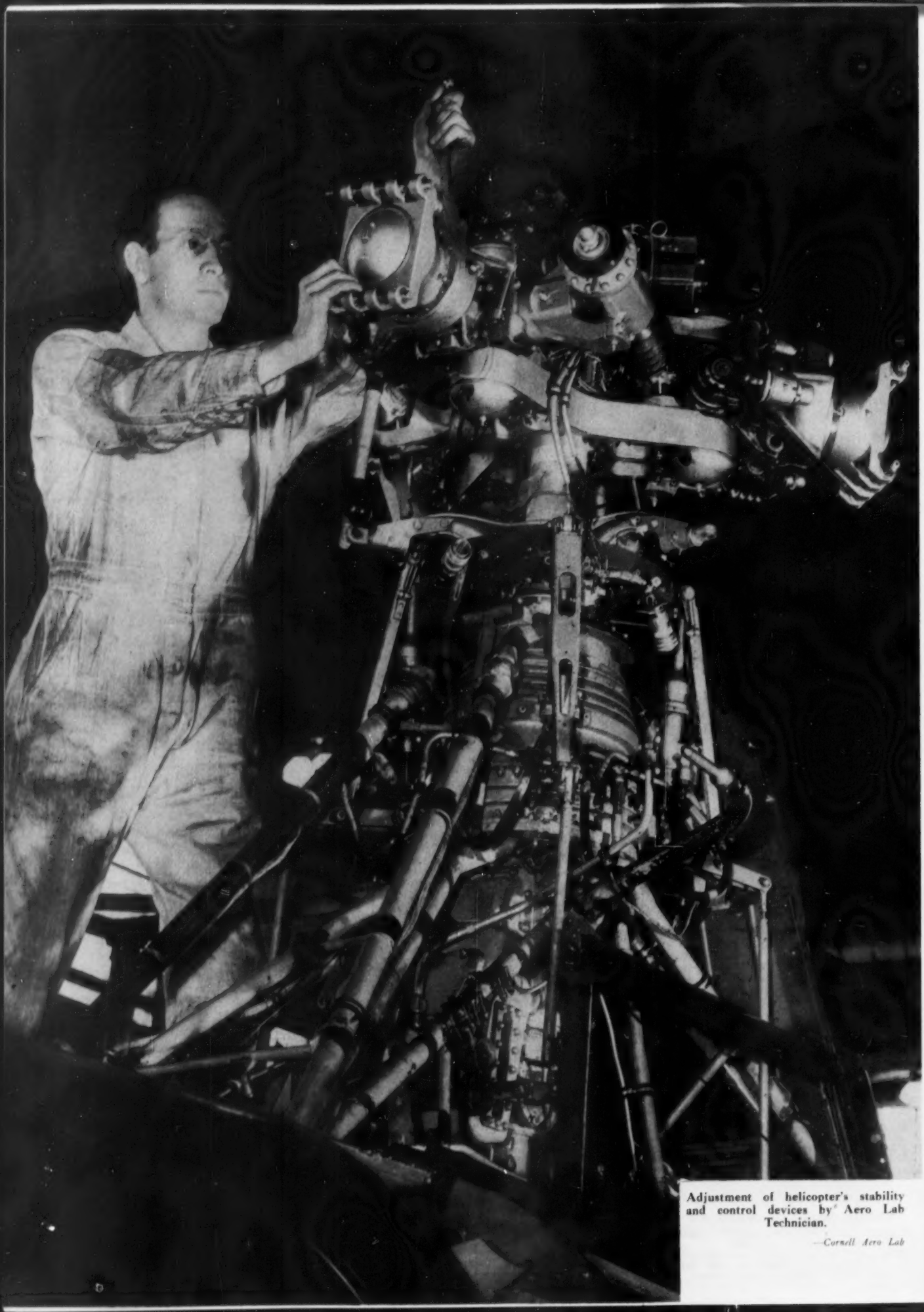

Adjustment of helicopter's stability and control devices by Aero Lab Technician.

—Cornell Aero Lab

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Cornell Aero-Lab Research

by

ALAN S. ROSENTHAL, EE '60

A comparatively small number of Cornellians are aware of the fact that the University owns one of the country's prominent research laboratories. The Cornell Aeronautical Laboratory, Inc. of Buffalo represents a major segment of Cornell's research effort as well as being an important research center for the entire country. Under the general direction of Dr. T. P. Wright, vice-president for Research of the University, the research laboratory has been playing a part in the development of air missiles and in the improvement of safety, air and automobile, and in many fields of aeronautics.

The Laboratory has a rather interesting history. In 1945 when many airplane companies found that they had to consolidate their holdings in order to economize, the Curtiss-Wright Corp. felt that it could no longer use its Buffalo laboratory. Rather than completely dismantle the equipment and dispose of the building, the company gave the entire plant to Cornell University as a gift. This grant included a good deal of equipment among which was a large subsonic wind tunnel. Dr. Wright became President of the laboratory in 1948. Having greatly expanded since acquisition by Cornell, the organization now employs 1,150 persons who do research in an extremely wide range of studies. Its Director is Dr. I. G. Ross.

During the years of its existence, the Cornell Aeronautical Laboratory has made many outstanding contributions to the field of general science as well as air science. One of its important developments was that of a wind tunnel capable of producing transonic wind speeds without the problem of unwanted interaction between the airstream and the tunnel walls. Before the use of supersonic air speeds, these problems were not encountered and a wind tunnel like the one used at Cornell Aeronautical Laboratory was adequate for measuring the interactions between the plane model and the airstream. However, as air speeds increase, the interactions between the airstream and elements of the tunnel becomes noticeable, prohibiting testing in the transonic range.

Although the interaction effects stemming from model support systems probably never will be entirely eliminated, they have been minimized by placing the model-support strut where it has the least effect—out the rear of the model. Along with this so-called sting-type support have come intricate miniaturized balance systems using electrical strain gauges mounted right inside of the test model.

The interaction effects contributed by the tunnel walls were not as easily remedied as was the interference problem posed by the model support system. Experiments showed that the interaction effects caused by the walls were actually two-fold: those interactions which occurred at transonic speeds and those which became prevalent at supersonic speeds. The main problem that confronted the research technicians in transonic speed airstreams was the fact that the walls in a conventional wind tunnel actually squeezed the airstreams together causing inaccurate results; coupled with this was the reflection of a shock wave back from the wall onto the model. A suggested cure for the problem was the removal of walls entirely, but it was found that this remedy caused the streamlines to become dilated. The answer to the entire problem seemed to be a compromise between walls and no walls. That is, a tunnel with alternate walls and slots, (open sections) running in the direction of the airflow.

The slotted-wall wind tunnel was a possible combination. Because of the sharply discontinuous nature of disturbances in a supersonic stream, however, the large alternate solid and open sections of the slotted wall result in alternate compressions and expansions, which do not merge and self-cancel and are reflected back to the model. The Laboratory in its approach to the wave cancellation problem reasoned that the use of a porous wall, that is, a wall having continuously distributed open and closed sections rather than one having discrete, large-scale open and closed sections, would result in coalescence or absorption of the reflections close to the wall and yield a considerable attenuation of the reflected disturbances at the model location.

The solution of the problem proved to be the use of perforated metal sheets for tunnel walls. Experiments verified the efficacy of this system, and, at present, the United States Air Force is sponsoring further investigation in this area including rebuilding of the old subsonic tunnel.

The development of the wind tunnel was a Cornell Aeronautical Laboratory project closely related to the field of aviation. Many of the organization's projects seem to be further afield from aeronautics. One such project was the development of a building that could be supported by air. This type of structure was needed to protect large, long-range radar antennas against high winds and severe winter weather. The mushroom shaped structures, commonly called "radomes", were found to withstand the imposed stresses of the elements while they did not interfere with transmission.

The radomes, which were developed by C.A.L. and tested on its

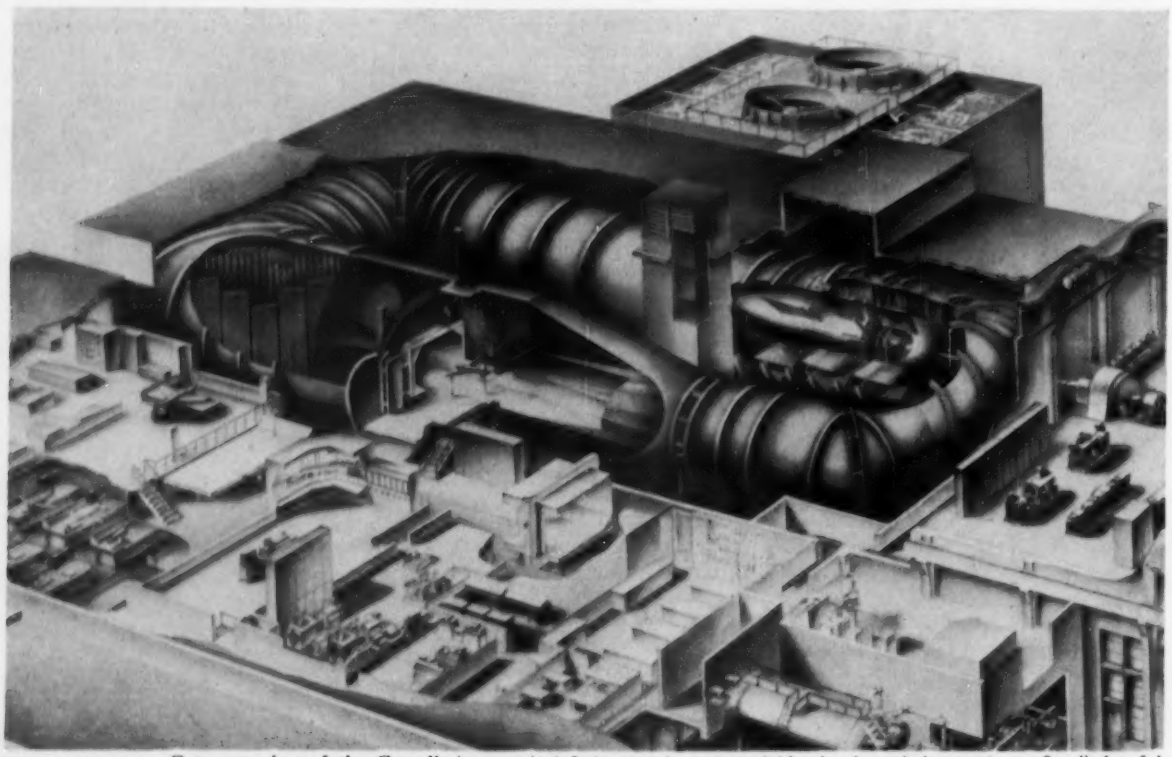
premises, provided interesting problems in construction techniques. Aerodynamic loading is quite different on radomes than on conventional structures because of the radomes' smooth, spherical shapes. In addition to the normal wind pressure, high negative pressures (pulling out on the envelope instead of pushing it in) are developed which reach a maximum in a plane approximately ninety degrees to the wind direction. These aerodynamic loads, together with the inflation pressure, result in a wide variation of the load action on the surface of the radome.

The amount of distortion in air-inflated structures depends on the shape, loading, materials used, and general design. Excessive distortion of such structures will alter the aerodynamic loading because the new shape causes a change in airflow across the surface. This effect produces still further alteration in loads and may result in excessive stress concentrations. The spherical shape of the air-supported radome was chosen because spherical units can redistribute load with a minimum of distortion.

Another problem with which technicians were confronted was the question of the type of material to be used for the structure. The poor tear resistance of conventional fabrics proved to be a major difficulty. However, materials development programs were initiated, and new fabrics and coatings became available. C.A.L. has developed a two-ply material which can be punctured with an 8-inch spear while under full design load without further ripping. Synthetic yarns have been developed which, when used for coated fabrics, provide a strength-weight ratio equal to that provided by aluminum or structural steel. Many of these new materials have weathering and sunlight resistance much better than that normally associated with synthetic fibers. Maintenance problems are thereby greatly reduced.

Although the air supported building principle has been used successfully in many military camps and radar stations, its major advantage may well lie in commercial areas of use. The advantage of inexpensiveness and the absence of supporting structures make it appear quite possible that the structure will be used extensively for commercial purposes in the near future. In fact, according to Dr. Wright, the University is considering the use of the "radome type" structure for the proposed ice skating rink.

Because of the need for air locks or some other means of preventing excessive loss of air when entering or leaving air-supported buildings, the feasibility of handling large crowds in this type of structure has been frequently questioned. A simple air lock might be used on the majority of air supported structures today but it is not a necessary restriction. Revolving doors of a relatively simple design can be used to provide for continuous passage of people with a minimum loss of air. The air that is lost through the doors is easily replaced by the large volume, low pressure blowers which would be used both for ventilation and inflation of the structure. Whether the higher pressure inside the building would cause discomfort to the occupants also has been questioned. A pressure difference of only a few ounces per square inch is required to support the roof of even very large structures. Inasmuch as this pressure difference is far below the pressure changes which occur in the normal atmosphere from day to day, no physical discomfort should result.

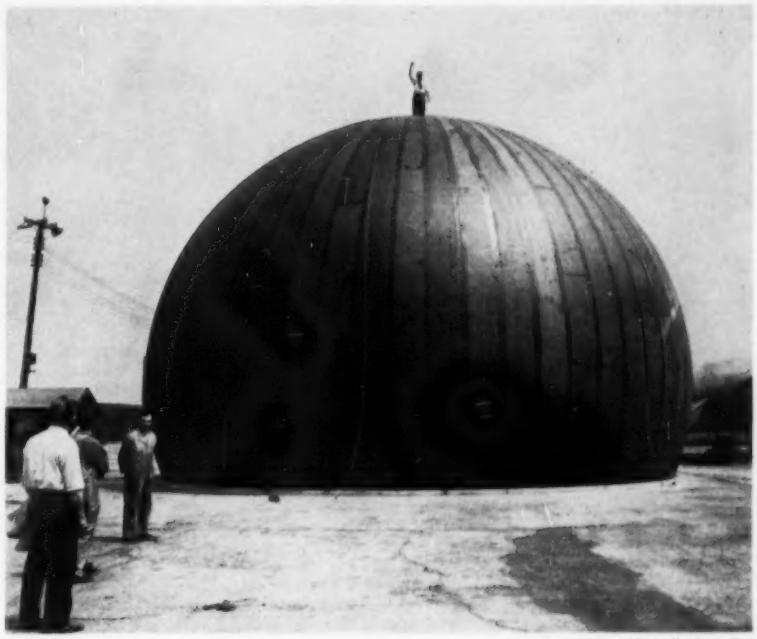


Cut-away view of the Cornell Aeronautical Laboratory's new variable density wind tunnel. —*Cornell Aero Lab*

The problem of keeping the structure inflated is not overly difficult. Even power failure or mechanical failure would not cause the structure to deflate. In case of a mechanical failure, standby blowers would be on hand. A small standby power unit would be kept in case of a power failure. If the blowers were to stop for an extended period of time, the enclosure is so large in comparison to the various openings that it would settle extremely slowly. Moreover, a lightweight cable system could be used to prevent the roof from settling too far in case of an emergency.

One important program of Cornell Aeronautical Laboratory is to investigate the problems of automobile safety and to attempt to reduce the number of accidents. Working under the premise that a certain number of automobile accidents are unavoidable, technicians have attempted to find methods by which an individual can be in a severe traffic accident and still survive. In this area of research C.A.L. has been a noteworthy pioneer. An article in the February 19, 1956 issue of the *New York Herald Tribune* mentions the organization's part in the recent car safety improvements. The Cornell Aeronautical Laboratory is not the only Cornell organization working on automobile safety research. The Cornell Committee for Transportation Safety Research has C.A.L. as a member as well as segments of the campus here at Ithaca and the Crash Injury Research Group at the Cornell University Medical College in New York City. The purpose of this committee is to determine ways to reduce the number of deaths and injuries due to automobile accidents.

The basic premise under which C.A.L. has been working in auto safety is that of a "package deal." The Laboratory is treating the problem as though automobile passengers were items in a container. Since no one would consider sending a package loosely wrapped on a journey, C.A.L. technicians have developed devices like car safety belts to give the passengers the protection of a carefully wrapped package. The safety belt is an item carried over directly from air safety techniques.



—Cornell Aero Lab

Exterior of the air-supported radome designed by the Cornell Aeronautical Laboratory.

It is not necessary to cite specific figures here regarding the potency of the safety belt. Although the *New York Herald Tribune* did not use percentages that would indicate the belt's effectiveness, let it suffice to say that after exhaustive research the Laboratory found that safety belts are a great help in the prevention of deaths and injuries in automobile accidents. In their research, they used complicated devices to bring the crash test car to an abrupt stop, meticulously constructed dummies to simulate passengers, and a great deal of photographic equipment so that the effects of different accidents and safety devices could be accurate'y observed. They thought that the safety belt would be effective enough to warrant that a universal "do it yourself" seat belt be designed. This product, produced by C.A.L., is now on the market.

Despite these convincing proofs, the technicians realize that travelers may be reluctant to use the belts. Although the research workers feel that cars will be designed in the future so that the functions of the safety belt will be accomplished with absolutely no inconvenience, this time is some time away and waiting for these developments to occur could prove fatal.

Cornell Aeronautical Laboratory's extensive tests still leave some questions about the best ways to reduce fatalities caused by serious accidents. Steps originated at C.A.L. which car manufacturers have taken to provide better "packaging" for the passengers include padded dashboards, safety locked doors, and specially designed steering wheels. All these contribute to safer travel, but there is still a "long way to go" before research is completed.

These projects are only a very few of the many fields of study in which C.A.L. is engaged. Many more problems have been investigated, and progress has been made toward their solution. At this moment the Laboratory is engaged in government research, much of it classified, as well as many other fields of study. Progress is continually being made.

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Campbell's Bluebird

by

BRUCE AUGUSTUS, ME '59

The sound barrier and the four minute mile have been the two most recent stumbling blocks in the path of man's quest for greater speeds. These, plus the most recent, the water barrier, comprise an immortal triumvirate which will endure as a symbol of the great achievements of the Twentieth Century. The first living man to successfully surpass the water barrier was Donald M. Campbell in his jet-powered speedboat, *Bluebird*.

Thirty four year old Campbell is the son of the late Sir Malcolm Campbell, holder of many land and water speed records. The name, *Bluebird*, was originally used on Sir Malcolm's propeller driven speedboat, which set the world's water speed record at 141.7 miles per hour in 1939. This record was held by Sir Malcolm until his death in 1949, at which time Don began attempts to surpass his father's mark. For three successive years, misfortune and unforseen accidents prevented Campbell from achieving this goal. Meanwhile, in the United States, Stan Sayres had brought the record up to 178.5 miles per hour with his *Slo-Mo-Shun IV*. Still standing, this record is believed to be a maximum speed for propeller-driven boats, and especially those of the conventional hydroplane design.

At speeds in excess of 180 mph, the nose of the craft tends to rear up out of the water. If this effect becomes excessive, the air blast will cause the boat to be momentarily airborne, which at high speeds is nearly always disastrous. The answer to higher speeds seemed to lie in a new hull design, but it was soon found that this change would have to be accompanied by a change of powerplant, and the jet was the obvious solution. The idea for a jet driven speedboat is not new, however, for as early as 1952 John Cobb, holder of the world's land speed record, tested a jet powered boat at Loch Ness, in Scotland. Cobb's tests proceeded according to schedule until his *Jet Crusader* began to approach 200 mph, when a slight shaking was felt. The *Crusader* did 206 mph on the first part of the official record run, but before Cobb could turn around for a return trip, the boat mysteriously disintegrated. A smiliar accident occurred in the Autumn of 1954, when Italy's Mario Verga was killed when his jet boat approached 200 mph and suddenly flew apart.

The Water Barrier was becoming more clearly defined. Two hundred mph seemed to be the maximum water speed before boats flew apart in much the same way as planes did when approaching the sound barrier a few years ago.

The Water Barrier

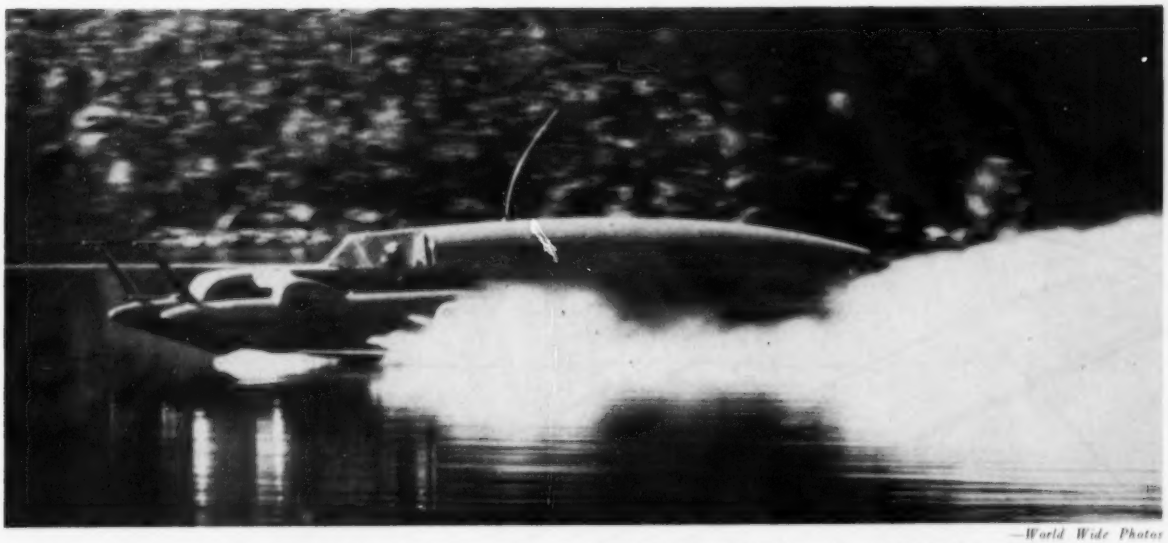
Campbell believes as boats approach 200 mph, speed-created pressures between the hull of the boat and the surface of the water cause a shaking which will inevitably tear apart the boat. The consequences of this phenomena were grimly evident to Cobb and Verga.

The sound barrier is a series of shock waves created by sound waves which are compressed by an airplane's forward motion. Campbell believes a parallel situation in the water causes an uncontrollable pitching of the boat, which has given rise to the water barrier, or oscillation barrier. As a boat nears 200 mph, the high frequency vibrations in the water reach the point where the boat can no longer absorb them, metal fatigue results, and the boat flies apart. Campbell believed that the boat, to break the water barrier, must possess extreme strength, have a small area of surface contact, and small frontal areas to minimize flight tendencies. Out of these ideas the *Bluebird II* was born.

The Bluebird II

Campbell and his crew of engineers began work on the design of the Bluebird in the late part of 1949, and by the summer of 1955, the *Bluebird II* was making trial runs of over 180 mph. Over two years of actual construction time, at 11 hours a day, and $80,000 went into the *Bluebird*. Thirty wind tunnel and towing tank models were built and tested before the final design was chosen. Then a radio-controlled model was built, incorporating all the desired features into a working replica. This mock Bluebird was successfully tested at 90 mph on Lake Ullswater. Satisfied with the results of three year's work, Campbell then began full scale production on the *Bluebird II*.

The completed *Bluebird II* is a 24½ foot long, 2½ ton, steel framed hull, with two forward floats on which the boat rises when it reaches



—*World Wide Photos*

Donald Campbell, son of the late speed king Sir Malcolm Campbell, pilots his jet-engined speedboat bluebird over lake at Ullswater, Westmoreland, England, July 12. During test run on that day Campbell unofficially broke world speed record, traveling nearly 200 miles an hour.

40 mph. The high tensile steel frame is covered with a corrugated aluminum alloy inner skin to stiffen the frame and reinforce the smooth aluminum alloy outer skin. The estimated safety factor is twice that of a supersonic jet fighter. That is, the *Bluebird II* is supposed to be able to withstand a deceleration or shock of 27 Gs. The chosen power-plant is a Metro-Vickers turbojet design which develops 4000 lbs. static thrust. Dual air intake ducts are located on either side of the hull directly behind the entirely glass-enclosed cockpit. Alongside the cockpit are the two floats, on which the boat planes. Two supporting steel spars project from the hull, one aft and one forward of the cockpit to hold the floats in place. These, also, are covered with a skin of aluminum alloy to reduce wind resistance and add strength. The stern of the craft is a broad, flat planing area, which forms the final supporting surafce of the three point planing hull. Located at the stern also are two ballast tanks which may be drained or filled to any level to adjust the trim of the boat. They may also be removed for alterations or repairs to the hull or engine. The 50 gallon circular fuel tank, which girths the turbojet about its forward section, is placed at the center of gravity in order that it may empty during a run without altering the boat's balance due to loss of the fuel's weight.

Controls

The cockpit of the *Bluebird II* is, in itself, a masterpiece of engineering foresight. The dashboard contains only four instruments: a tachometer, fuel pressure gauge, tailpipe temperature gauge, and airspeed indicator. The airspeed is conveyed to the instrument panel by means of external pitot tubes, or pressure heads, mounted on the forward section of the floats. On the cockpit floor, directly in front of the specially designed pilot's seat, is the foot throttle and a left foot rest. The hand throttle, foot throttle governor, and fuel control switch are mounted on a panel accessable to the pilot's left hand. Also, on the left side of the cockpit, slightly below the instrument panel, are the control knobs for the dump valve for unburned fuel and a release for the *emergency brake* parachute. The pilot's right hand is left free to control the steering wheel, from which there is a mechanical connection, by means of a gearbox and control rod, to the port-offset rudder. The small rudder was moved to one side after a few trial runs, in order to avoid the hull backwash that occurs at low speeds.

Safety Devices

There are many safety devices on board which may not be accurately termed controls, but which are invaluable to the boat's success. Behind the pilot's head, in a special compartment, is the electronic equipment. This consists of a transmitter and receiver, which are tuned to the radio equipment in Campbell's shop. Placed at all strategic points on the boat's hull are strain gauges, vibration measuring devices, and roll and pitch indicators. These are all wired to the telemetering system, which automatically relays all the information gathered to shore, whenever the boat is in operation. The six-channel high-frequency set also provides for intercom between the pilot and his men on shore. In the event that something goes wrong during a run, or any part of the boat shows excessive strain or vibrations, the vital statistics are instantly transmitted to shore, where television screens, oscilloscopes, and other high precision electronic devices inform the shore crew to warn Campbell of trouble over the intercom. The unit also provides a check on itself. In the event that any part of the warning system or controls should fail during operation, a buzzing sound is immediately heard in the pilot's headphones. All information radioed to shore is electronically recorded, even while it is being received. The reasons for this are to preserve all the valuable information for future use, or, if an accident occurs,

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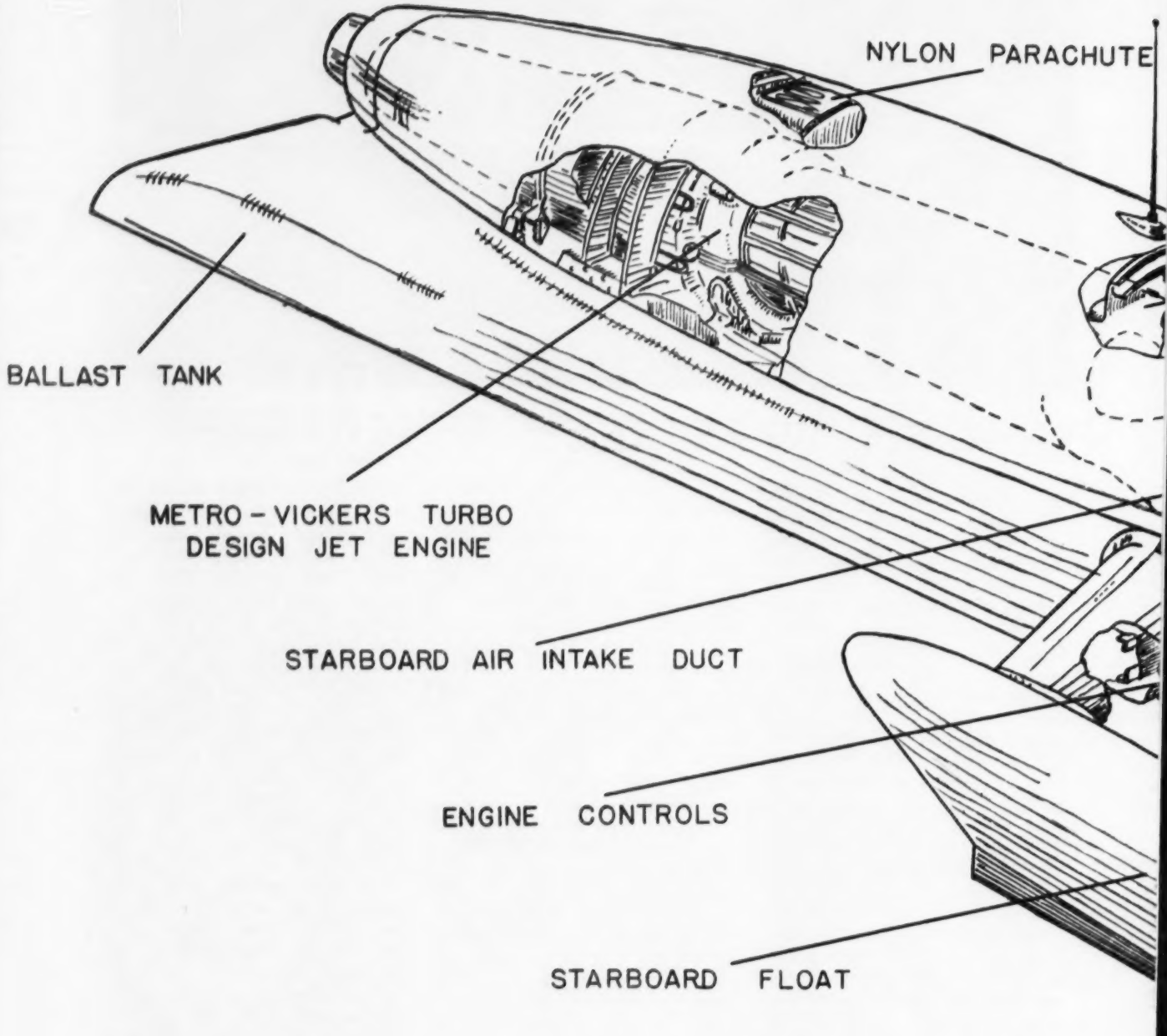
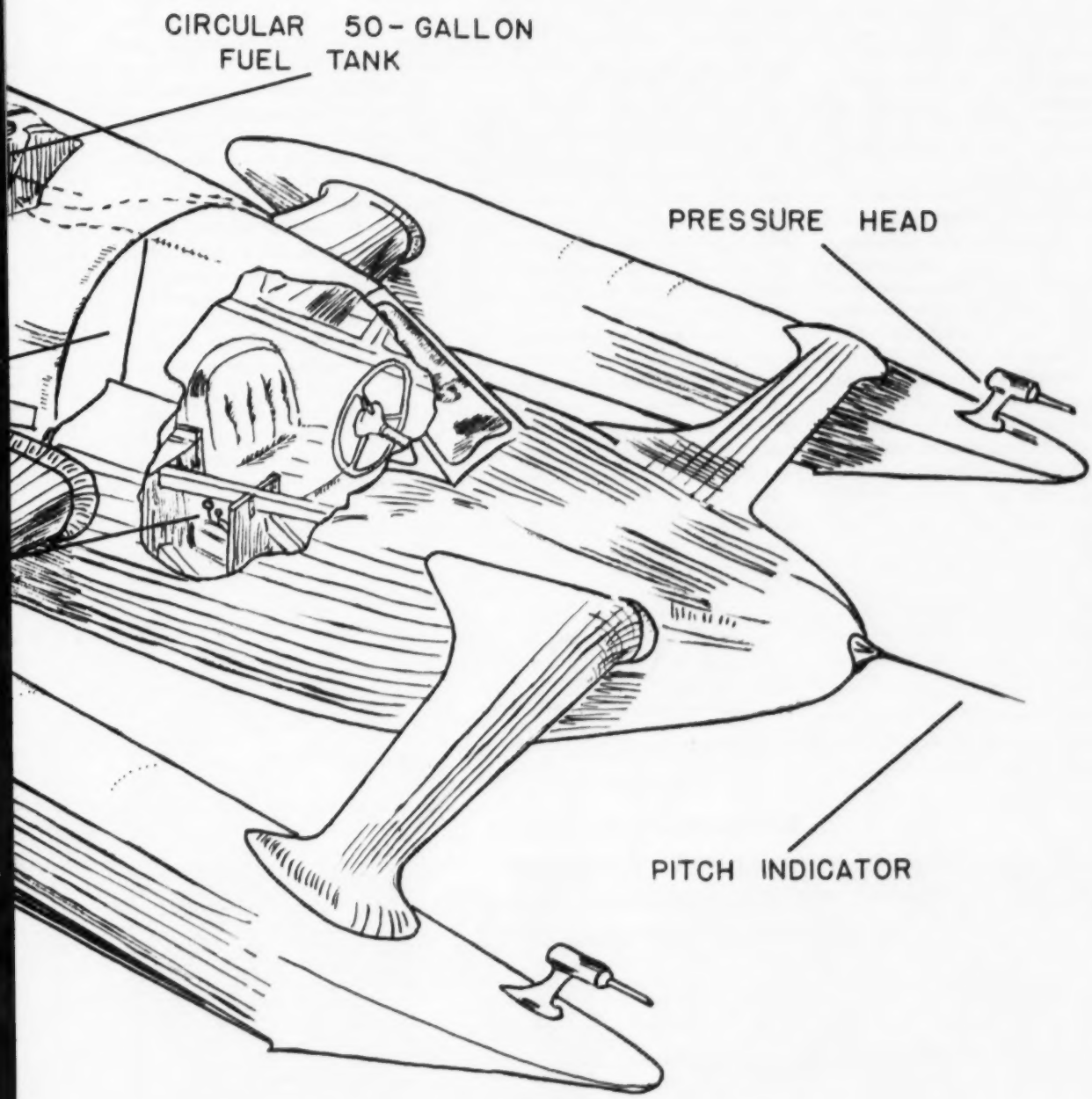


Diagram of General Features of



The Bluebird Jet Speedboat

—*Sports Illustrated*

the statistics will still be on record for the exploitation of following experimenters. In Campbell's own words: "If she goes down, at least all that valuable data will stay dry."

All the equipment hitherto described has been designed for the purpose of foretelling and preventing any mishaps while the boat is being tested. But just as a means for conserving the technical data in the event of an unforseen disaster was painstakingly calculated, so were the means of saving the life of the pilot, and as much of the boat as possible.

The specially designed pilot's seat mentioned previously, is in reality an upward ejection seat that functions in much the same way as ejection seats in modern supersonic airplanes. The *emergency brake* parachute also serves a dual purpose. It may be used to slow the boat to a stop after a trial run, or, in case of an accident, it will automatically jettison from its compartment in the boat's stern and slow the craft to a controllable speed. Models of the boat's cockpit and seat were tested in submarine tanks for pressure leaks to an estimated depth of two hundred feet below the surface, and with the help of Leo Villa, Sir Malcolm's top mechanic, a pressure suit was developed for Campbell to wear that would provide him with a 45 minute supply of air under water, conscious or not.

Testing The Bluebird

By early summer of 1955, the *Bluebird* was complete and ready for its first trial runs. In the early tests at Lake Ullswater, England, Campbell guided the shiny dart across the surface of the lake at 150 mph with the throttle open half way. A few days later a trial run of 180 mph was made with still plenty of power in reserve. It was then, however, that a fault in the hull design was noticed. As soon as 180 mph was reached, flying spray from the boat's wake clouded the windshield so Campbell could see nothing. One month was set aside to correct this fault, but it was more difficult than originally believed, and an additional month was necessary before the problem was satisfactorily eliminated. The eventual solution was the insertion of two aluminum plates, or baffles, between the nose of the boat and the inboard side of each float. Incorrectly placed, these could cause additional wind resistance and flight tendencies, so the angle of the baffles had to be carefully and accurately determined before further high speed tests could be accomplished. After the installation of the baffles, there was only to wait for the right weather for the final trials, and then the official record run. Finally, one afternoon during the last week of July, 1955, weather conditions were favorable. Lake Ullswater was a mirror, unbroken but for the waiting form of the potent *Bluebird*. Receiving a call from his Chief Engineer, Campbell left his chess-board and raced to the dock, where his crew of helpers were anxiously waiting. The powerful jet whined into life and

(Continued on page 30)

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Ag Engineers Use New Building

ALAN CARLIN, EP '60

Fifty years ago the phrase "agricultural engineering" had hardly been coined. Last fall the Cornell Department of Agricultural Engineering started to move into its new quarters, $2.75 million Riley-Robb Hall, just east of Alumni Field and west of the one story building which had served the department for the previous 43 years. The rapid growth of this youthful department at Cornell has been paralleled throughout the country by the attempt of the profession to keep up with farm mechanization, the monster which it was created to tame and guide.

The department had its roots in the Department of Rural Engineering and Architecture, created in 1907 with offices in the basement of Roberts Hall. This early department was organized by Professor Emeritus Howard W. Riley, who headed it under its numerous titles until 1944. Cornell's department was one of the first in the country, and was founded the same year as the American Society of Agricultural Engineering, of which Professor Riley was a charter member and later a president.

The name was not the only ever-changing quantity in the department; in 1912, the renamed Department of Farm Mechanics moved to a 40 by 90 foot "temporary" wooden structure on the site of the present Mann Library. Despite numerous moves and additions, this building was still occupied by the department last year. The first of these additions was built around a Case thrashing machine the following year and, surprisingly, named Case Hall. This same year the name was switched for a second time—to the Department of Rural Engineering. Another "temporary" addition, a 40 by 90 foot laboratory, was constructed in 1918. Finally, in 1924 the building was moved to its present location on Judd Falls Road, and six years later the department name was switched to its present form. The only acquisitions after that time were two quonset huts, built in 1947-48, and the U. S. Army corps of Engineers' Soils and Concrete Laboratory, acquired in 1949.

A post war State building planning committee started plans for the new building in 1944, and architects (Coffin and Coffin of New York City) were engaged in 1946. Just one more prerequisite was needed—money. The 1953 Legislature finally appropriated it, and ground was broken that September. The first steel beam rose March 4, 1954; during the next two months, workmen riveted together 570 tons of structural steel, besides the 240 tons already imbedded in concrete. The building was enclosed by winter and first occupied in October, 1955, when it was dedicated to Professor Riley and to Professor Emeritus Byron B. Robb, Cornell's first student in agricultural engineering and director of the department from 1945 to 1947. Although hammering is still audible from within at times, the exterior of the five-story head building and two-story wings are now finished, with their brick walls, trimmed with granite, limestone, and marble. The construction costs amounted to $2.25 million dollars and equipment, $490,000; the Department gained 110,000 square feet of floor space, enough for laboratories, classrooms, and offices for the entire department.

The new building will be used by the Department to carry out its three-fold responsibility: resident instruction, extension teaching, and research. The teaching program is two-fold; besides offering 19 courses to approximately 650 College of

(Continued on page 50)

—*Photo Science*

Professor O. C. French holds door of new agricultural engineering building open for Professors Emeritus Byron B. Robb and Howard W. Riley to whom the building was dedicated.

—*Photo Science*

Aerial view of Riley-Robb Hall from the southwest.

Faculty Profile

Professor David Dropkin

by

JOHN WALSH, ChemE '59

Professor David Dropkin of the Mechanical Engineering School has been associated with Cornell University most of his life. He started studying mechanical engineering at Cornell University in 1929. In 1933 Professor Dropkin received his M.E. degree from the University; this was soon followed by M.M.E. and Ph. D. degrees.

In 1936 Professor Dropkin was appointed a McMullen Research Scholar, a position he held for one year. The following year he was appointed a Research Associate. From 1938 until 1943 Professor Dropkin was a Westinghouse Research Associate. From 1941 to 1943 he also held the position of Instructor at Cornell. From 1943 until 1946 Professor Dropkin was Assistant Professor of Mechanical Engineering. In 1946 he was named Associate Professor of Mechanical Engineering.

Professor Dropkin has done research on a variety of subpects mostly concerned with heat transfer for several industrial organizations and institutions. One of his most interesting research problems concerned heat transfer in liquid metals. In 1949, Professor Dropkin was appointed Visiting Engineer at Brookhaven National Laboratory. In the year he spent at Brookhaven. he was concerned with heat transfer problems of atomic reactors. Because of the classified nature of the project entailed. However, the not free to explain in detail what the project entailed, However, the project was of such interest and importance that the following year Professor Dropkin sent one of his more advanced graduate students to do further work in that general field. The work this student did helped to qualify him for his Ph. D. When this student graduated from Cornell, Professor Dropkin sent another graduate student in his place. So far, this system has worked out fine for all concerned: the research done is very valuable to the government; Professor Dropkin's students get to work with project apparatus otherwise out of their reach (e.g., a $100,000 mercury heat exchanger now in operation); and Professor Dropkin can help keep the project advancing—a project which has held his interest ever since he began working on it.

When Professor Dropkin started doing research in the field of heat transfer, he found that he needed a room which could be maintained at a constant selected temperature in which to run his experiments. So before 1940, he designed a constant temperature room which was constructed at Cornell. Later he designed a second larger room which was insulated on all sides, floor, and ceiling by thick slabs of cork. Heating and refrigeration units

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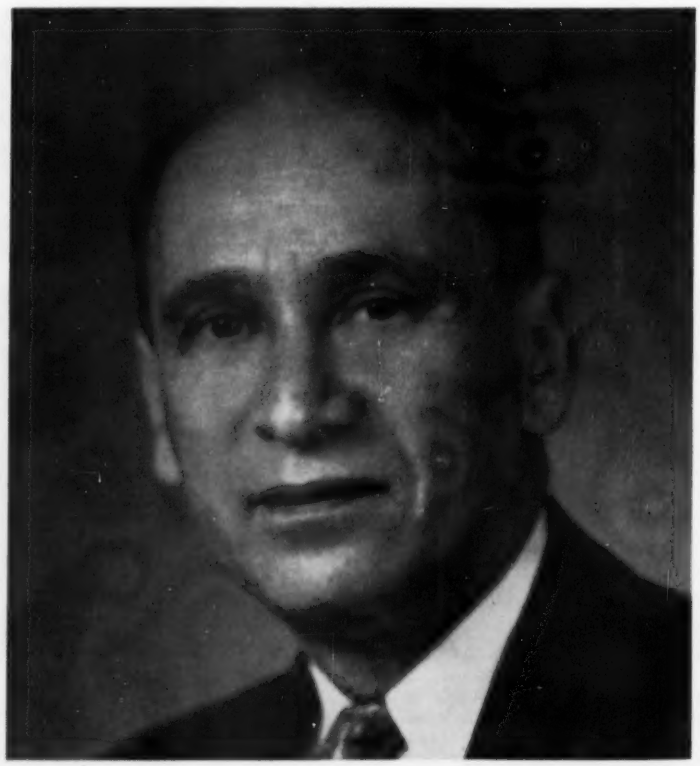
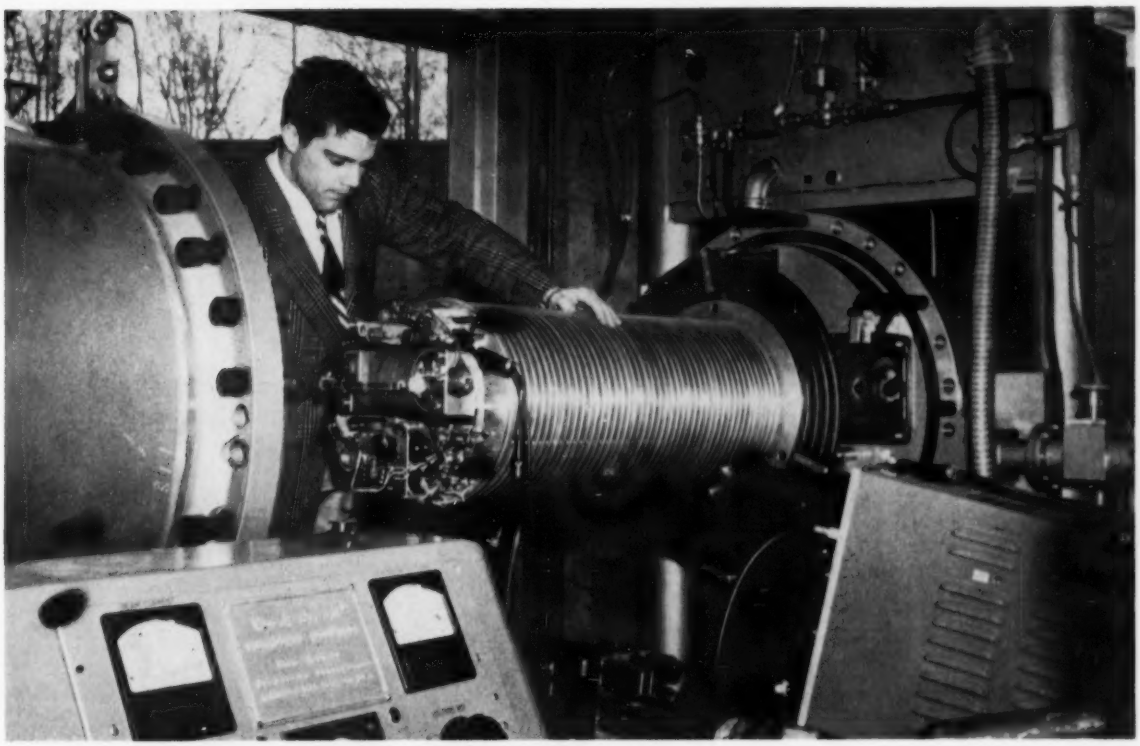




Student examining Cornell's Van de Graaf generator.

E-Day At Cornell

Engineer's Day at Cornell is the annual Spring "Coming-Out Party" for the denizens of Sibley Dome. Each of the seven engineering schools plus the College of Architecture provide exhibits, both in their respective buildings and at various outdoor spots, which are somewhat representative of the work being carried on in the colleges. The foreign car exhibit, one of the highlights of last year's E-Day, which was located in front of Sibley Hall by the ME school, will probably be continued this year, with more and newer cars.

Color television is expected to be shown by the EE school, according to Lee Mackensie, E-Day Chairman for the College of Electrical Engineering who also spoke hopefully of reshowing the *color organ*, a marvelous electronic device which transforms music into colorful patterns. An extensive indoor exhibit is planned by the college of Metallurgical Engineers. Gary Kirby, chairman of this division has plans for demonstrations of the foundry's arc furnace and welding equipment. There will also be displays, both in the foundry and in Olin Hall, of surface hardening experiments of metallography. The Department of Engineering Physics will sponsor presentations at Newman and Rockefeller Halls, in both of which the Nuclear labs will be open to the public. In Rockefeller lecture room A, fifth year EP's will present some of the favorite lecture demonstrations of Professor Grantham, former Physics 115-116 lecturer, which have won his weekly hour the title of "Grantham's Circus."

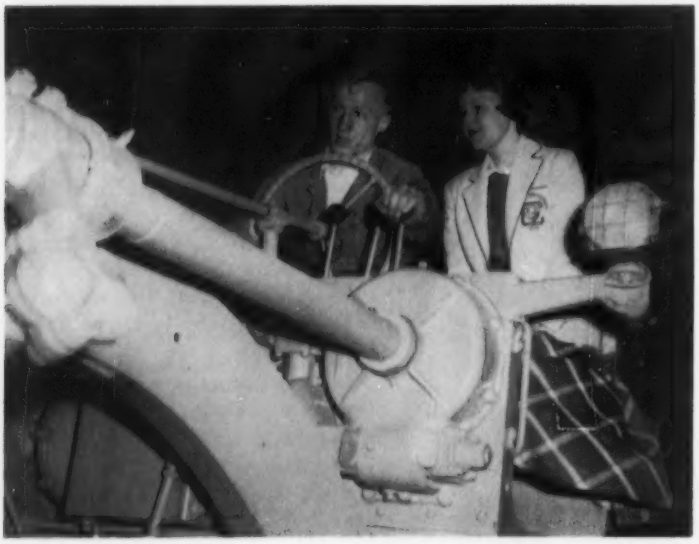
This year for the first time, the three-year old college of Agricultural Engineering will have displays on E-Day. Lacking a convenient location in which to show their exhibits, the Ag. Engineers will most likely be outside, perhaps on the site of the recently-razed Naval Gun shed.

According to Roger Baldwin, this year's Publicity Chairman, the 1956 E-Day should show an improvement in coordination between the various schools, although many of the exhibits will be the same as last year's.

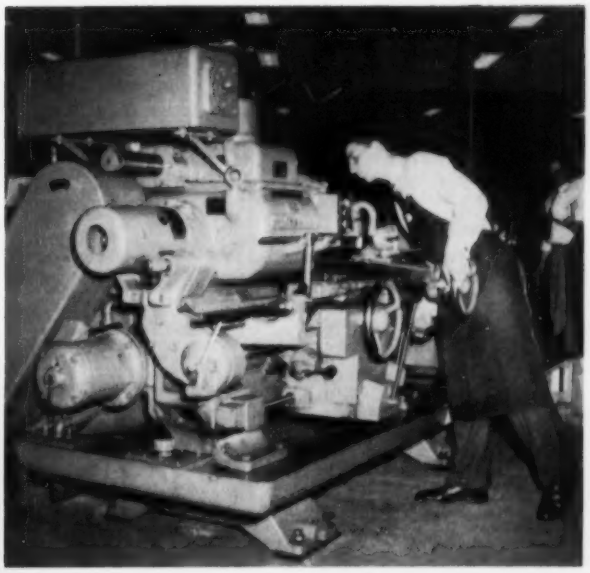
Other students acting as E-Day Chairmen include John Baldeschwieler, judging chairman, Jim Francis, program chairman, and Jack Hanna, Chairman of Engineer's Day.

Exhibit of freshman drawing projects

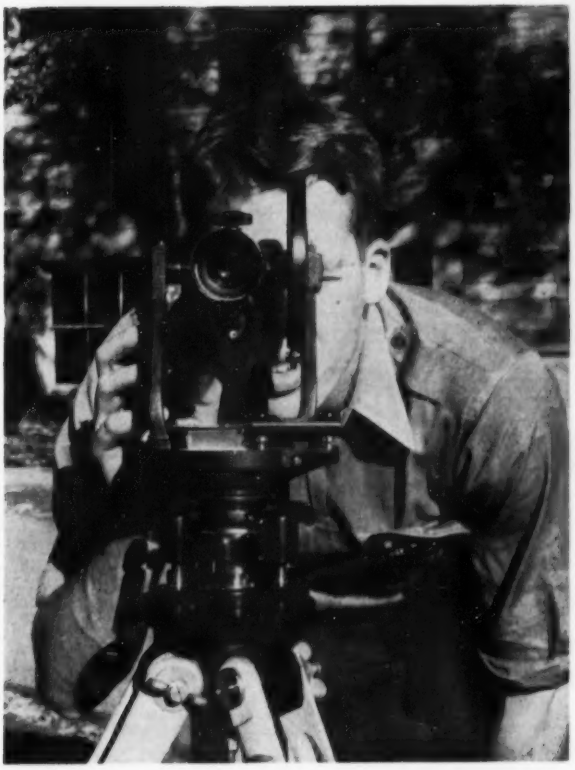
Gas crucible furnace used for melting metal in the foundry.



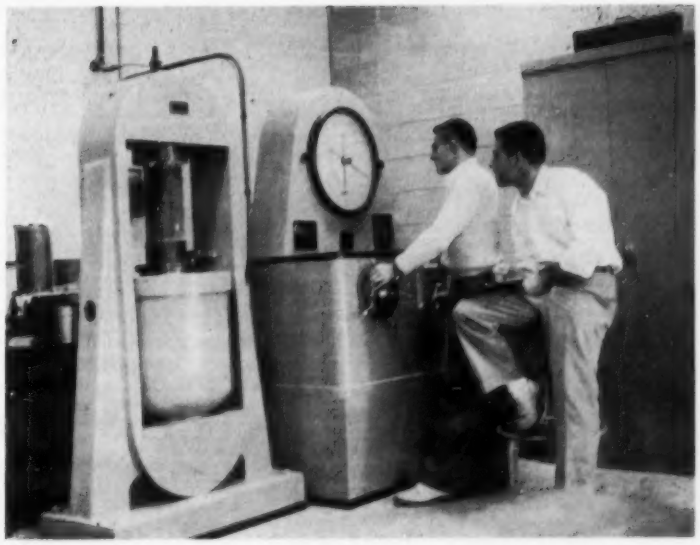
Large tractor used in earth-moving projects.



Metal machine lathe being operated by a prospective engineer.



Freshman engineer demonstrating use of a theodolite.



Making a compression test on one of the University's testing machines.

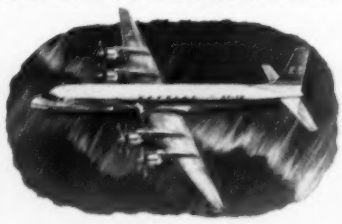
F4D, "SKYRAY"— only carrier plane to hold official world's speed record

A4D, "SKYHAWK"— smallest, lightest atom-bomb carrier

RB-66 — speedy, versatile jet bomber

A3D, "SKYWARRIOR"— largest carrier-based bomber

C-124, "GLOBEMASTER"— world's largest production transport



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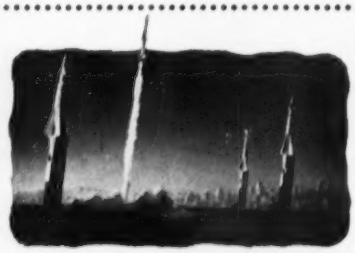

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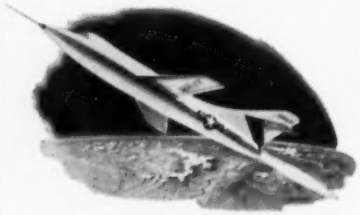

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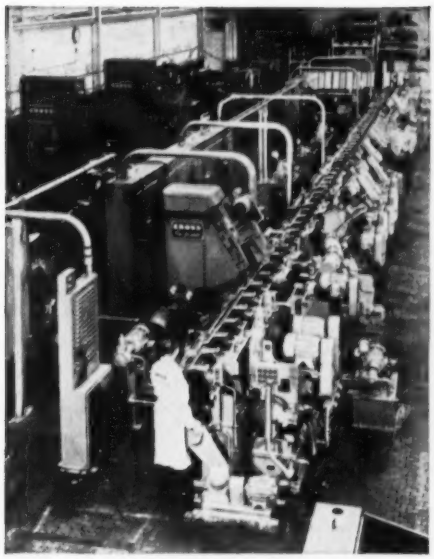

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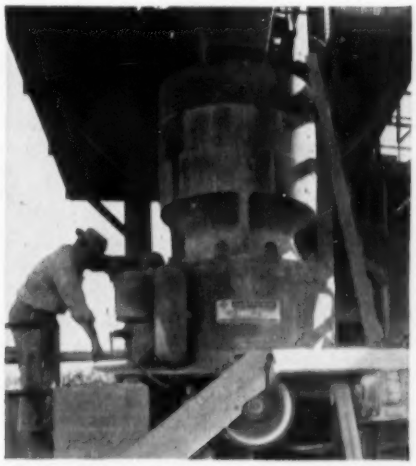

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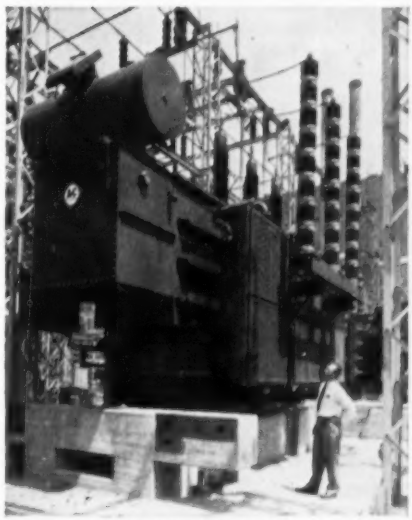

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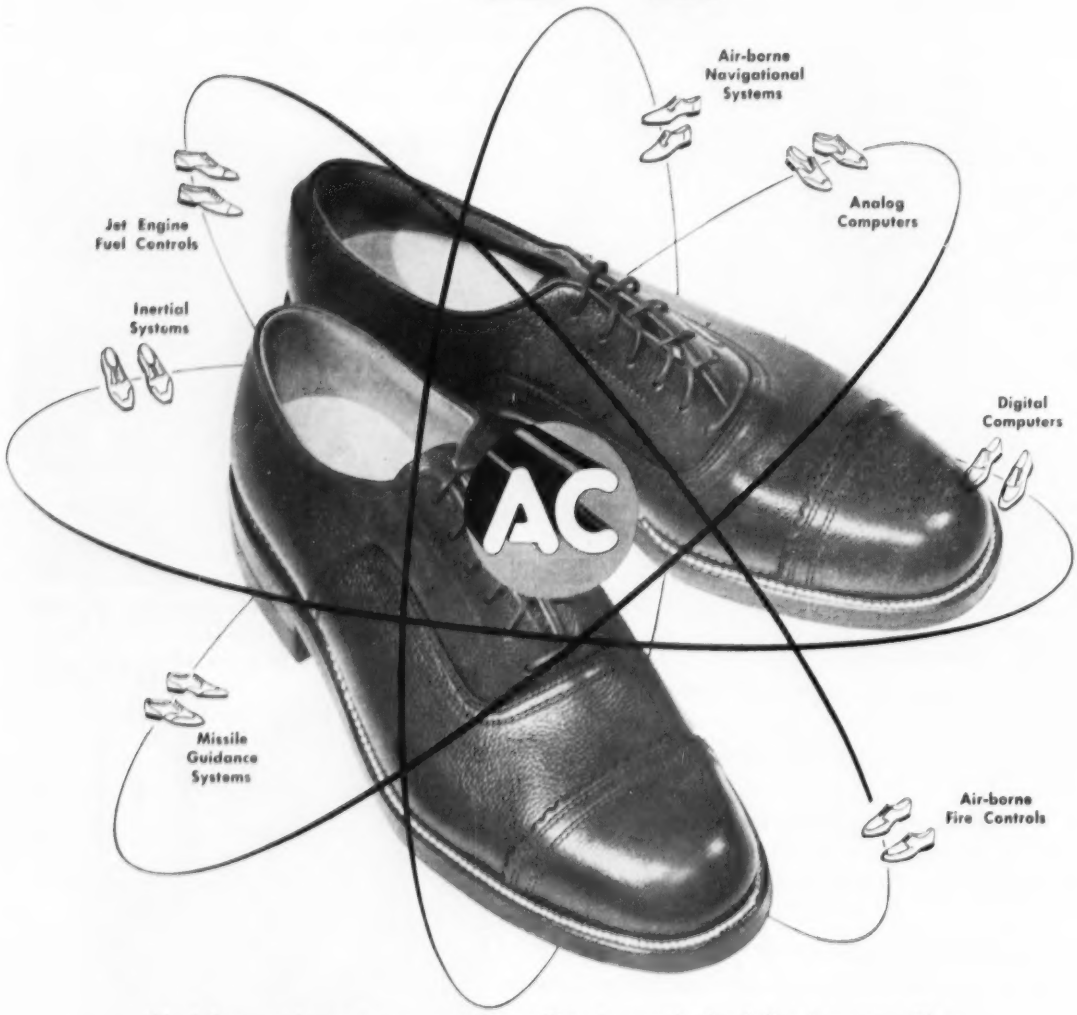

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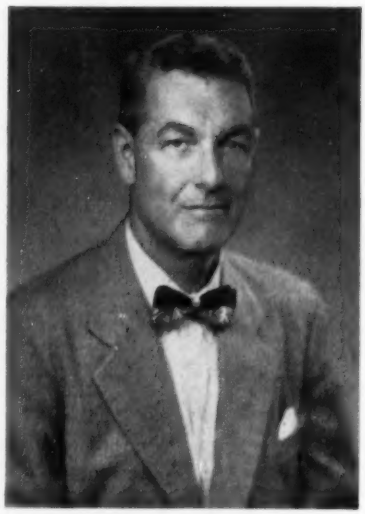

William M. Leonard

"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University, its graduates, and former students and to establish closer relationship between the college and the alumni."

As I sit here, I've been wondering if I have not been taking myself as an engineer entirely too seriously. My regard for engineering as a profession and for engineers as useful characters goes back even beyond my happy and learning years at Cornell. In the intervening years this feeling has been constantly enhanced by my personal contact with engineers at work and by the work of engineers. Now, for the moment at least, I am not so sure.

A word of explanation is in order. I've just spent a couple of hours with an alleged friend, name of Darby. This Darby is the man you've heard of often; he always finds, after reassembling a device as simple as a wheelbarrow, that he has three or four parts left over. In his younger days he failed in a try-out for the bat boy's job on the Dodgers; took seven seconds to change razor blades. Even so, he's been bending my ears about engineers and engineering.

Engineers, he says, may be dramatic, even glamorous, but they're not practical. "They suffer from the long view," Darby maintains, "and we ordinary guys put up with hundreds of minor and major inconveniences because of it. What engineering needs is more myopia and less utopia.

"Far away people," he says "ask an engineer if it's going to be a nice day and he whips out his sliderule. Ought to look at the sky. Proud because they can steer a guided missile 1,500 miles with fabulous accuracy but they neglect to invent a device for the dashboard to tell me how many inches my wheels are from the curb.

"Do they concentrate on developing a bobby pin which won't make my kid's teeth crooked, or a vacuum cleaner tool which will get the dust from in-between the tubes of my radio amplifier? No, fifty engineers will concentrate on designing a machine which will do the work of fifty clerks and needs fifty mechanics and technicians to service it.

"And the language they use, their own combination of Lingua Franca and pidjin. They can only talk to each other. Even then, after an engineer devotes an hour in telling a crowd of his fellow engineers what he's working on, the meeting committee hands out the text in printed form so the listeners can take it home to figure out what he really meant.

"Moreover, they're romantic. Look at their diplomas. Are they made of modern, cheap, easy-to-clean, attractive plastic material? Not a bit of it; an engineer's diploma has to be a weather-beaten hunk of dust-collecting parchment, hard for the penman to letter on. And take the lettering! Do you think our streamlined engineers demand a clean-lined, easy-to-read, scientifically designed type face. No, again. Nothing will satisfy their sentimental souls but an illegible, present-day simulation of the medievalist's inept brush scribbles.

"Goes for their college buildings, too. If it weren't for the non-engineering economic pressures of high-price stone work and skyrocketing maintenance costs, engineers would still be building Gothic reproductions for their new study halls and inducing spider-encouraging ivy to grow over them.

"Too many engineers are slaves to tradition, custom, and practice. Took them over a hundred years to get the locomotive engineer out in front where he could see where he was going. Old Man Stevenson, no egghead but a coal miner who didn't know better, put the engineer on the tail of his locomotive where the smoke could blow in his face, and three generations of engineers followed his example. When are they going to realize that because the horse was in front is no reason the engine of a passenger automobile has to be?

"The worst is yet to come. Just look at the things engineers are working on now. The telephone one can see over, for example. Just picture the tired businessman of the future telling his wife he's working overtime at the office while, over his shoulder she can see the bartender mixing up a fresh batch of martinis. And can't you see the housewife scurrying around dusting the living room and putting the chairs back in place before she picks up the receiver? And what will happen to the good old game of "Guess Who?" And 3-dimensional television; imagine your wife letting you tune in on Esther Williams!

"And now there is a big hullaballoo about needing far more engineers. Lew Fields of the vaudeville team of Weber and Fields put it in a nutshell a half-century ago. 'Civil Engineers!' he exclaimed in horror, 'what this country needs are some civil conductors'."

Well, Darby did have me disturbed for a while, but no longer. For a moment, I considered taking my sheepskin down from the wall and tossing it into the wastebasket. But as I reached up for it, I noticed the calendar hanging alongside. The date was April 1.

—William M. Leonard, *President*

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ALUMNI ENGINEERS

Mr. William W. Dickhart, III, M.E. '43, has been named Chief of the Machine Design and Development Section of The Franklin Institute Laboratories, Philadelphia. During his four years as a member of the Laboratories' Engineering Mechanics Section, Mr. Dickhart has been engaged in designing, analyzing or trouble-shooting, and testing machines for various clients of the Laboratories. One of his projects applied radioactive tracer methods to detecting potentially dangerous cavities that lie beneath Philadelphia's streets.

In his new capacity Mr. Dickhart will guide a staff of designers and engineers through design, development, construction, and a test of a variety of machinery and structures for industry and for the military.

Prior to joining the Laboratories staff in 1952, Mr. Dickhart served as Testing Engineer on stress and vibration problems in rail cars and locomotive trucks for the General Steel Castings Corp., Eddystone, Pa. He was awarded a B.S. Degree in Administrative Engineering by Cornell University in 1943, and a M.S. degree in Mechanical Engineering by the University of Pennsylvania in 1951. In the interim he spent three years as an Ordnance Officer in the U. S. Navy.

He is a member of the Society for Experimental Stress Analysis, the Philadelphia Engineer's Club and the U. S. Naval Reserve. He and his family reside in the Mt. Airy section of Philadelphia.

Henry M. Chestnut of 148 Hewett Road, Wyncote, was appointed Superintendent of Manufacturing for the Curtis Publishing Company. Mr. Chestnut, a native Philadelphian, joined Curtis in 1937 and prior to this promotion was its Chief Engineer and Assistant Manager of the Engineering Division.

Melvin A. Beesinger, CE, has been made manager of the Philadelphia downtown office of International Business Machines Corp. He went with IBM in 1935 and left it in 1941 for duty for five years with the Army. He became New York sales representative upon his return and was made branch manager at White Plains in 1953. In August, 1954, he took over as branch manager of New York uptown.

William W. Dickhart, III, M.E. '43.

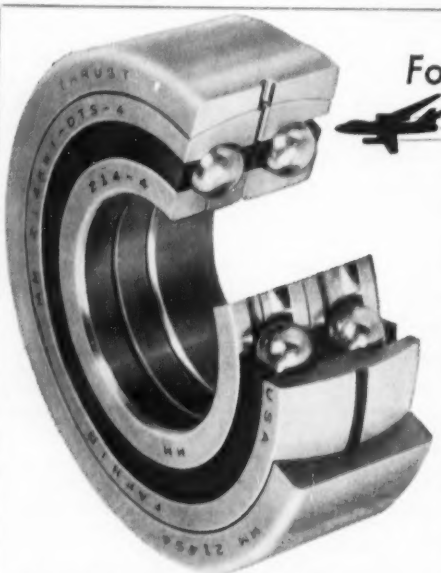
Edward J. Williams, C.E. '33, is vice-president and general manager of Armco Colombiana, S.A., a direct subsidiary of The Armco International Corp. of Middletown, Ohio. His address is Apartado Nacional #775, Barranquilla, Colombia, S.A.

William C. Rosenthal, ME, was tendered a dinner in his honor, August 25, by fellow employees of International Harvester Co., farm tractor engineering dept., at Chicago on the occasion of his retirement.

David G. (Dave) **Hill, ME '24** has been elected president of Pittsburgh Plate Glass Co. The announcement was made, December 15, by Harry B. Higgins, board chairman. Dave has been vice-president in charge of glass manufacturing.

Joseph Motycka, M.E. '22, labor standards manager for Pratt & Whitney Aircraft Corp., East Hartford, Conn., is the newly elected president of the Cornell Club of Hartford. He lives at R.D. 3, Folly Lane, Coventry, Conn.

(Continued on page 30)



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Fafnir builds super-precision ball bearings with tolerances held to millionths of an inch and finishes to microinches. These bearings support jet engine rotors where they withstand high loads and speeds while compensating for distortion and maintaining shaft rigidity under blast furnace conditions.

The self-aligning jet engine ball bearing illustrated involves a radial and a thrust bearing assembled in one-piece self-aligning outer ring. All parts must fit together with extreme precision. Higher mathematics, metallurgy, mechanical and aeronautical engineering are required to design and construct such a bearing. The Fafnir Bearing Company, New Britain, Connecticut.

AIRCRAFT CONTROL BEARING CATALOG . . . available for university libraries. This catalog contains complete dimensional and load rating tables, scale drawings and a special engineering section featuring technical data.

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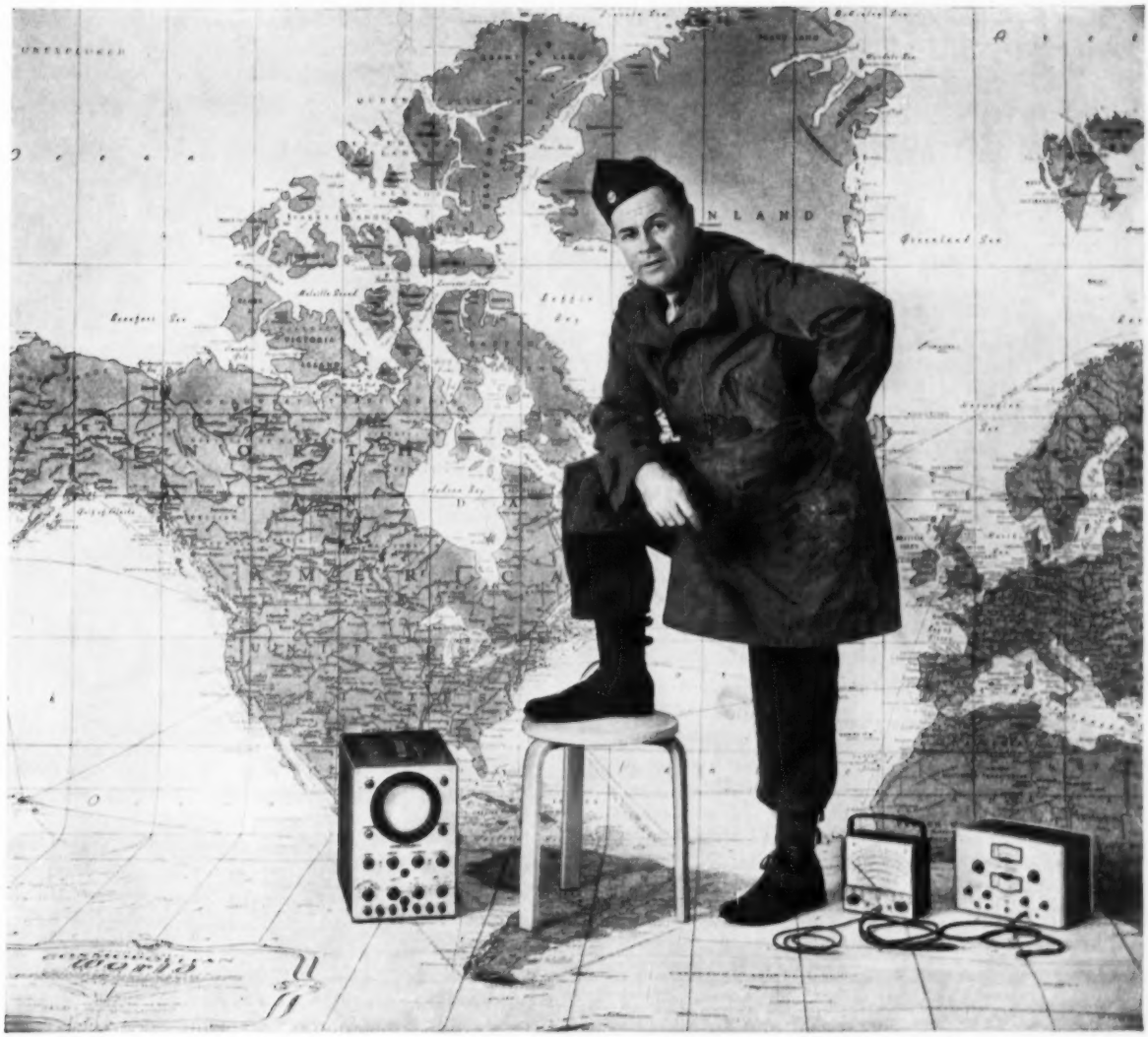

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In all these ways, the RCA Government Service Department has proved its ability to give added strength to our Armed Forces.

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RCA offers careers in research, development, design, and manufacturing for engineers with Bachelor or advanced degrees in E.E., M.E. or Physics. For full information, write to: Mr. Robert Haklisch, Manager, College Relations, Radio Corporation of America, Camden 2, N. J.

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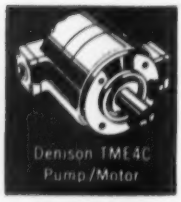
POWERFUL but light weight hydraulic motors now drive mixer drums on mobile trucks. No longer is it necessary to use separate gasoline engines that add up to 1500 pounds dead weight and take up a lot of space.



Denison hydraulic pump motor. Runs as a pump or as a motor.

A highly compact Denison hydraulic motor powered by a hydraulic pump on the truck engine controls the rotation of the mixer drum. The speed of the drum is easily varied to suit mixing requirement.

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(Continued from page 28)

Thomas M. Goodfellow, CE '29, vice-president and general manager of the Long Island Rail Road for the last sixteen months, became president and general manager of the line on January 1. One of the youngest railroad presidents in the country, he became operating head of the Long Island in August, 1945, when the railroad emerged from its five years of bankruptcy and embarked on a $60,300,000 rehabilitation program. He will continue as the active operating chief of the road and will also become a member of the railroad's fifteen-man board of directors. He was superintendent of the Pennsylvania Railroad's Pittsburgh division when he was chosen to head Long Island's operations. Address: 130 Kilburn Road, Garden City.

Russell C. Germond, M.E. '09, retired December 31 as superintendent of the steel division of The Stanley Works, New Britain, Conn. He joined the company in 1909 as an experimental engineer in the steel division and three years later became foreman of the cold rolling department. In 1918, he was named assistant superintendent and in 1922 he became superintendent. He is married, has one son and two daughters, and lives at 17 Hillside Road, Kensington, Conn.

James W. Cox, M.E. '09, consulting textile engineer, reports that he has just returned from 6½ weeks in Ethiopia, Africa, where he was making a survey of the textile industry. His address is 40 Worth Street, New York City.

C. Harold Berry, M.E. '12, retired as professor emeritus September 1 after twenty-seven years in the department of mechanical engineering at Harvard University. On the same date, he became professor of mechanical engineering at Northeastern University in Boston. From 1913-18, he was instructor and professor of heat-power engineering at Cornell.

Campbell's Bluebird

(Continued from page 16)

the *Bluebird II* roared off across the lake. Almost as quickly as it had begun, the test was over; the Bluebird streaked over the measured kilometer course and returned to the dock, where the astonished onlookers waited. Campbell squirmed out of his pressure suit and shuffled over to a nearby crane, calling to the operator, "I want to stretch my back." He took hold of the swinging hook and was lifted off the ground for a few minutes before he was gently lowered to the ground. Explaining his actions, he complained of an old back injury that was aggravated by the bouncing of the boat. By this time, the electronically computed results had arrived. Speed out—215.08 mph. Return speed—187.57. Average speed for both trips and a new world's unrestricted waterspeed record—201.32 mph! Campbell's only comment after the run was, "Bluebird was not out by a very long way. She ought to be able to go quite a bit faster."

This prediction turned out to be an accurate one, for on November 16, 1955, on Lake Mead, Nevada, Campbell shattered his own mark and set a new worlds unrestricted waterspeed record of 216.2 mph.

The *Bluebird II* K-7, as is the boat's full name, has a figure on the outside of her forward floats, which resembles a horizontal figure eight. This *lazy eight*, barely visible above the waterline, is the mathematical symbol for infinity. It indicates that the boat is in the unlimited power classification, which means it may not compete with other boats, but merely attempt to set speed records. Having fulfilled this duty, the *Bluebird II* is now being allowed to rest, and at the time of this writing may be seen in the Pennsylvania Railroad Station in New York City.

His lifelong ambition now realized, Don Campbell too may rest, for his name will be long remembered as the world's first conqueror of the *unconquerable* water barrier.

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Bluebird at the Barrier, Newsweek, July 25, 1955.

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Jet-driven speedboat built twice as tough as fighter, Popular Science, August, 1955.

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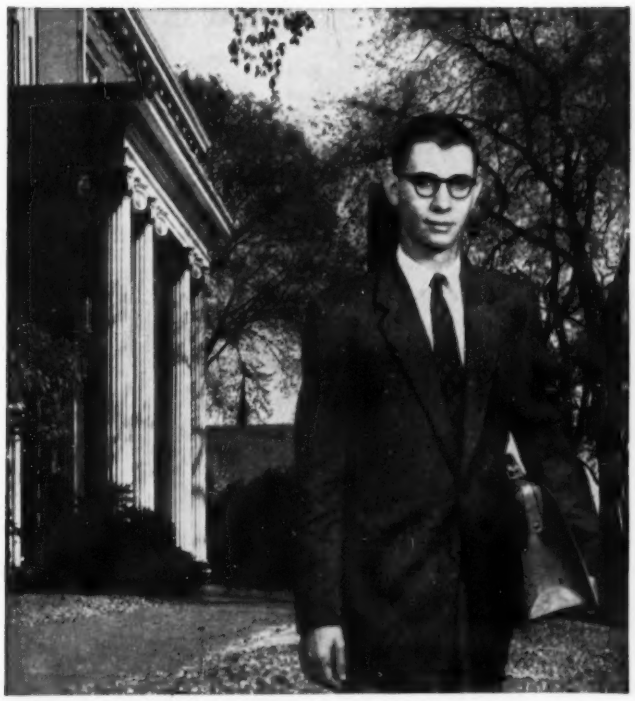

Gaylord E. Moss expects to receive his B.S. in Electrical Engineering from Tufts College in 1957. His interest in electronics was aroused, in part at least, by summer work in Du Pont's Photo Products Plant at Parlin, N. J. But Gaylord's interest in technical work goes much farther back. He received the Bausch and Lomb Science Award at his high-school graduation.

"Gay" Moss wants to know:

At what location would I work for Du Pont?

Clayton B. Hill, Jr., joined Du Pont's Jackson Laboratory at Deepwater, N. J., in 1940 and left for the Air Corps in 1942. After military service he obtained a B.S.Ch.E. from Pennsylvania State University (1949), and returned to Jackson Laboratory. Clayton was assigned to Du Pont's Atomic Energy Division for a period before transferring to the Personnel Division. As a representative of this Division, he currently visits many colleges and universities.

Clayton Hill answers:

Where would you *want* to work, Gay? The choice isn't quite so wide as that reply indicates, but if you have good reason for preferring a given area, and Du Pont has an opening there for which you're qualified, your choice will certainly be considered. We have 69 plants and over 70 research and development laboratories scattered through 26 states. So the odds are pretty fair that you can work in an area you like.

Most of the Du Pont units are situated east of the Mississippi, but some of them are as far west as the Pacific Coast. Right now, new plants are under construction in Michigan and California, providing even wider choice in those two states.

Of course, a man may be transferred after a time. The chemical industry is a growth industry, and transfers are generally associated with progress and promotions.

So you see, Gay, the geography of the United States is pretty much an open book for Du Pont professional men, adding a lot to their interest and enjoyment on the job.

WANT TO KNOW MORE about where you'd work with Du Pont? Send for a free copy of "The Du Pont Company and the College Graduate." This booklet contains a complete listing of plant and laboratory locations, by state, and describes work available. Write to E. I. du Pont de Nemours & Co. (Inc.), 2521 Nemours Building, Wilmington 98, Delaware.

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College News

Engineer Retiring Board

This March, with the election of the new staff of the CORNELL ENGINEER for the coming year, six past members of the staff retired. These retiring members are Bart DeGress, John Ahearne, Jerry Quinn, Leonard Pisnoy, Arthur Vaughan, Yale Brazel, and James Stewart.

Bart DeGress was Editor of the CORNELL ENGINEER this past year and had previously held the positions of Advertising Manager and Circulation Manager, with a total of four years service on the staff. Bart plans to spend three years in the Navy upon graduating from the mechanical engineering school in 1957, after which he hopes to work in foreign sales of engineering products.

John Ahearne has spent two years on the staff of the CORNELL ENGINEER in the capacity of Compet Manager and also as a member of the editorial board. John is in the Engineering Physics school and, after graduating in 1957, he is planning a three year term with the Air Force and also some work on nuclear physics or nuclear engineering as a graduate student.

Jerry Quinn has been with the magazine staff three terms, serving on the business board and carrying out the duties of Publicity Manager. Following graduation, Jerry will be continuing with his civil engineering work in the line of structural design after a three year hitch in the Navy.

Leonard Pisnoy has worked on the staff of the CORNELL ENGINEER the past few years in the capacity of Advertising Manager and Business Manager. Len is working toward both C.E. and B.P.A. degrees. After he graduates, Len plans two years in the Army followed by work in some occupation combining business and engineering—possibly in the line of sales.

Arthur Vaughan has spent two years on the staff of the magazine. He held the office of Associate Editor this past year and previously served as a member of the editorial board. Following graduation from the Engineering Physics school in 1957, Art plans to do graduate work in physics.

Yale Brazel has held the position of Office Manager and Advertising Manager in two of his four years on the staff. The other two years, he spent working on the business board. Yale is in the Electrical Engineering School and. after graduation this June he plans to spend three years in the Air Force.

Shown above are the retiring members of the Cornell Engineer. From left to right they are James Stewart, M.E. '56; Yale Brazel, E.E. '56; Leonard Pisnoy, C.E. '57; J. R. Quinn, C.E. '57; F. B. DeGress, M.E. '57.

Panel On Cornell Life

An informal student panel discussion on Cornell life was held during the Spring Recess in New York City for accepted engineering applicants to the Class of 1961. Sponsored by the Cornell Society of Engineers, the talks were intended to prepare the subfrosh for the Cornell atmosphere and to awaken them to the opportunities, for personal development on campus.

The panel was moderated by John D. Baldeschweiler, ChemE '56, chairman of the Engineering Council. His panelists were Bart De Gress ME '57, past editor-in-chief of the CORNELL ENGINEER, Donald Johnson ME '56, varsity crew member, Rod Rougelet EE '56, president of Tau Beta Pi and Donald Iglehart EP '56, varsity swimming team and NROTC student. One of the topics was "Why I Would Choose Cornell." The rest of the individual talks covered activities, athletics, academic training, and culture.

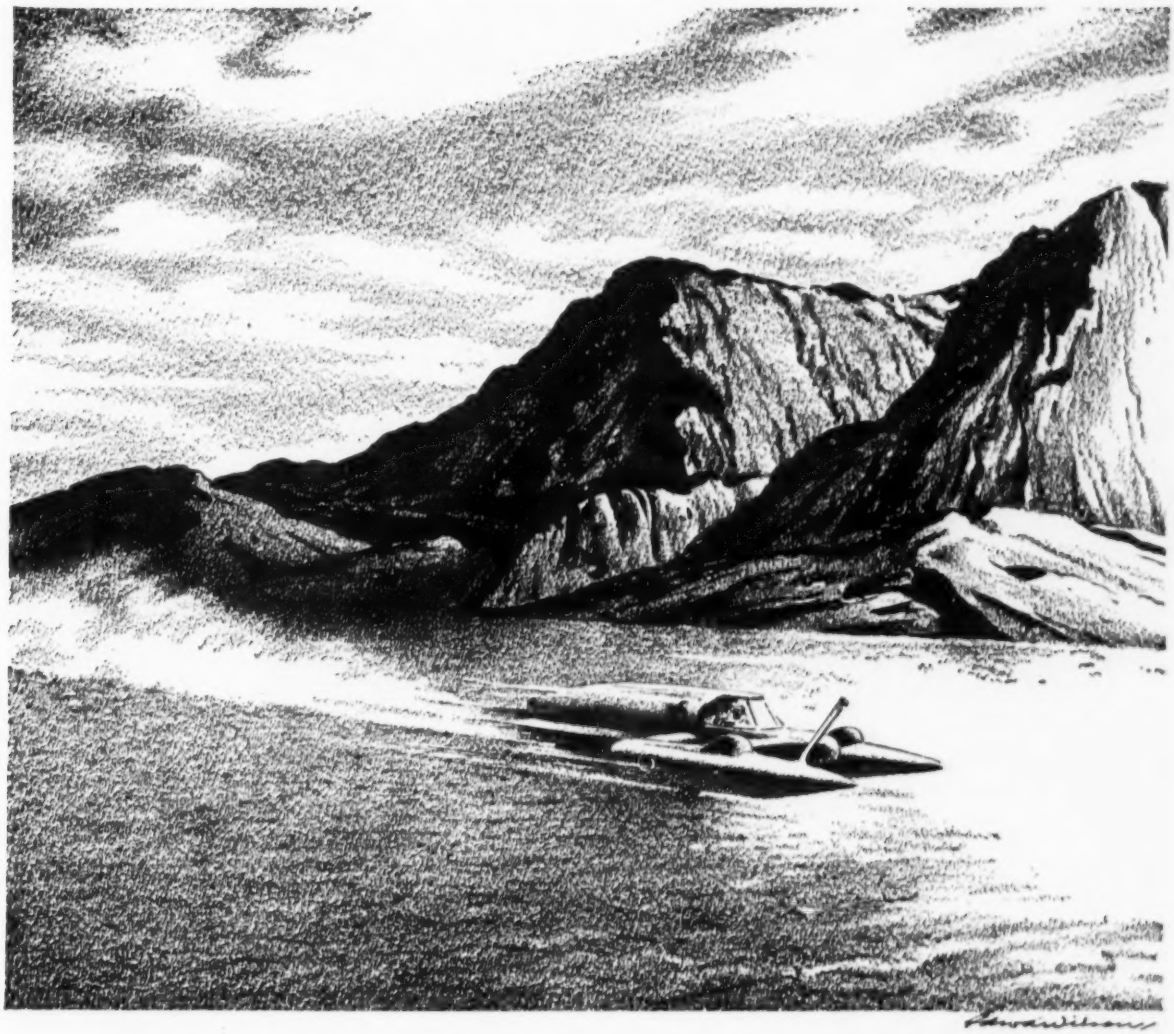
This pre-freshman orientation discussion was a continuation of successful programs in previous years. It was held in the Engineers' Club in New York on March 22.

Quarter-Million in Fellowships

Seventy-four of the nation's top college graduates will continue their studies during the current academic year under $250,000 worth of fellowships granted by the General Electric Educational and Charitable Fund.

Announcement of 40 General Electric Company fellowships valued at $135,000 in the fields of chemistry, physics and metallurgy brings to 74 the total of fellowships awarded this year. The first 34

(Continued on page 52)



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World's fastest jet boat, Donald Campbell's Bluebird—216 miles an hour . . .

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The J-57 axial-flow jet engine with
afterburner, designed and developed
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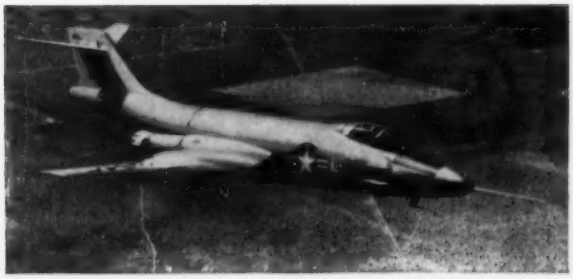
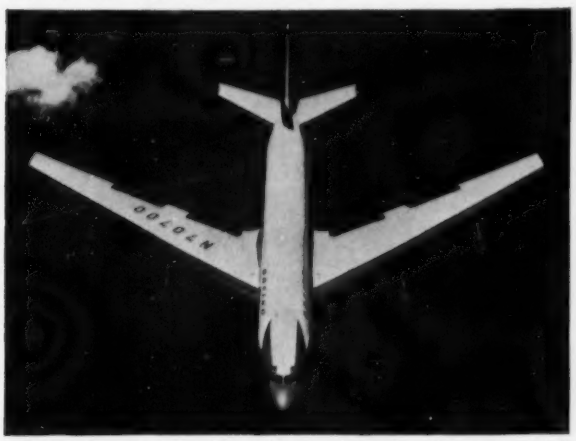
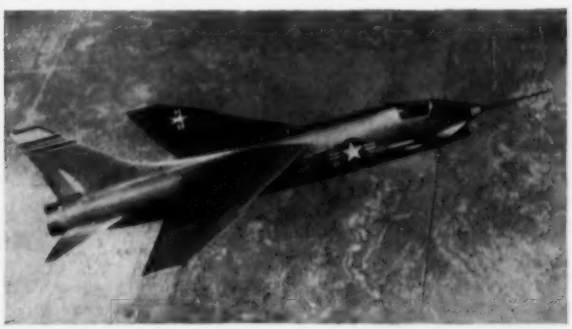


McDONNELL F-101 — The Voodoo, an Air Force supersonic fighter that has two J-57 engines with afterburners, is the most powerful jet fighter yet built.

BOEING B-52 — Eight J-57 engines, mounted in pairs, power this all-jet, heavy Air Force bomber.



BOEING 707 — The Stratoliner will usher in commercial travel in the jet age. It is the counterpart of the KC-135, a military tanker-transport powered by four J-57 engines.



CHANCE VOUGHT F8U — Powered by a J-57 with afterburner, the Crusader is the Navy's fastest carrier-based fighter.

The best airplanes... are designed around the best engines

Today's most valuable military aircraft, capable of supersonic or intercontinental flight, include various Air Force and Navy fighters, bombers and transports. Among these are nine types that have a significant feature in common. They all fly on one type of engine — the J-57 turbojet.

Also entrusted to the efficient, dependable operation of Pratt & Whitney Aircraft's jet engines will be the commercial jet transports soon to travel along the air lanes of the world.

The excellence of the J-57 is attributed to the engineering team that has determinedly maintained its leadership in the field of aircraft powerplants. Effort is now being directed toward the improvement of advanced jet and turboprop designs. Still to be anticipated is mastery of current technology's most provocative problem — the successful development of a nuclear aircraft engine.

Many engineering graduates would like to be concerned with the air power of the next generation. One way to fulfill that ambition is to pursue a career alongside the Pratt & Whitney Aircraft engineers who have consistently produced the world's best aircraft engines.

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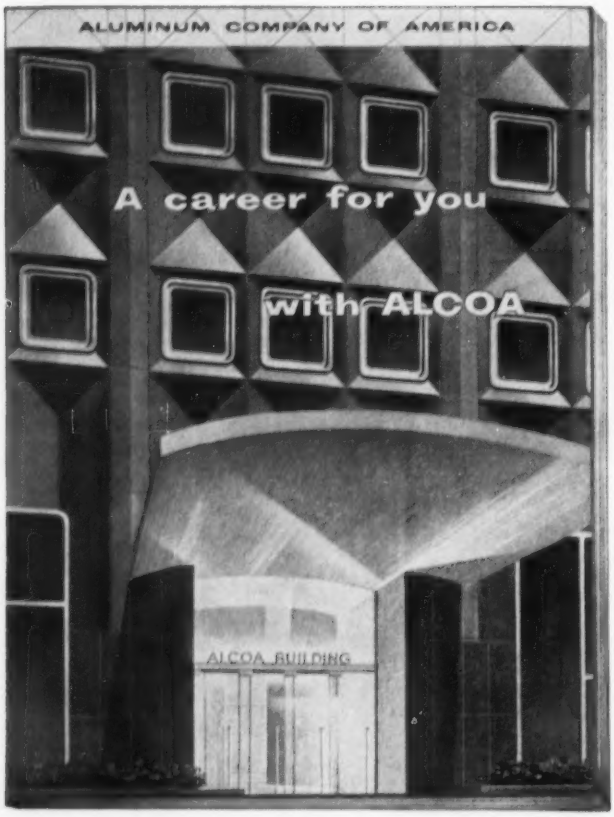

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this industry...
so **REWARDING**
its opportunities
...and so **VARIED**
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Book Review--

Mass Transfer Operations

by

R. E. TREYBAL

MASS TRANSFER OPERATIONS by Robert E. Treybal, Professor of Chemical Engineering, New York University, 666 pp., 1955, McGraw-Hill Book Company, 330 West 42nd Street, New York 36, $9.50, McGraw-Hill Series in Chemical Engineering.

This book supplies a long-felt need for a single volume which would give adequate treatment to the unit operations concerned with mass transfer and diffusion. Written primarily as a text for the study of these operations in colleges and universities, it may also be a valuable reference to the practicing engineer. An elementary knowledge of fluid flow and heat transfer is presupposed.

There is a gradual trend in chemical engineering education toward the study of unit operations in terms of generalized basic concepts, stressing their similarities as well as their differences. Professor Treybal's presentation is a step in this direction. Part One gives a clear picture of the fundamental concepts of diffusion and mass transfer involved in all the diffusional operations, covering molecular diffusion, diffusion in turbulent flow, diffusion in solids, and mass transfer between phases.

The remainder of the book includes chapters on humidification and dehumidification, gas absorption, distillation, liquid extraction, adsorption and ion exchange, drying, leaching and sedimentation, and a chapter on the less common operations of dialysis, gaseous diffusion, atmolysis or mass diffusion, and thermal diffusion. Considerable material is presented on equipment design and operation and other information useful in design calculations. There are 99 illustrative problems worked out in detail as well as unsolved problems at the end of each chapter. Recent advances in each operation and literature references are included.

There are a few omissions which might hinder the use of this book in a graduate level course, which the author suggests can be done. For example, there is no mention made of the Ponchon type of enthalpy diagram which is useful in the solution of distillation problems. In general, however, the coverage is very good and the clarity of presentation noteworthy. *J. S. T.*

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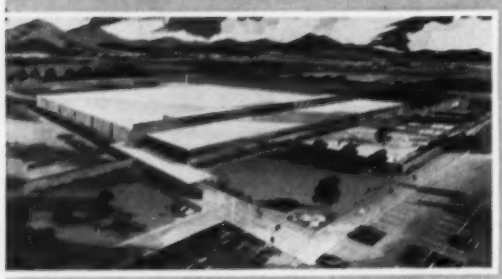

Denver manufacturing plant now under design

Infrared laboratory

Instrumentation laboratory

AIRBORNE ELECTRONICS AND WEAPON CONTROL SYSTEMS

Initial unit of flight test facility

Communications pilot line production

Simulators in computing center

At Ramo-Wooldridge today there exists a wide range of projects intended to aid aircraft in navigating to the vicinity of targets, finding the targets, destroying them, and returning safely to base. Work is under way in such fields as infrared and microwave detection, information display, communication and navigation, and analog and digital computing. Some projects are in the laboratory development stage, some in the flight test stage, some in pilot production.

Good progress is being made in the establishment of facilities and operational patterns that are well tailored to the unique requirements of advanced electronic systems work.

Positions are available for scientists and engineers in these fields of current activity:

Communications Systems
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Airborne Electronic and Control Systems
Electronic Instrumentation and Test Equipment
Guided Missile Research and Development
Automation and Data Processing
Basic Electronic and Aeronautical Research

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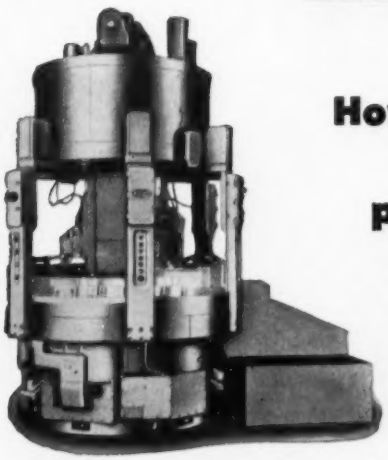
Another page for **YOUR BEARING NOTEBOOK**

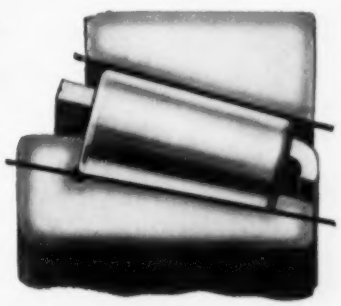


How to locate shafts accurately on high-speed precision chucking machine

Engineers designing the new Bullard Mult-Au-Matic Type "L" vertical chucking machine were faced with the problem of achieving high precision despite heavy work loads and high speeds. To do this, they used Timken® tapered roller bearings to furnish the precision and load-carrying capacity required at the locating position.

Full line contact gives Timken® bearings extra load capacity

Because the load is carried along a full line of contact between rollers and races, Timken bearings have extra load-carrying capacity. And their tapered construction permits them to take radial and thrust loads in any combination. Result: shafts are held in rigid alignment, shaft deflection and end play are minimized, gears mesh smoothly, spindle precision is assured at high speeds.



Want to learn more about bearings or job opportunities?

Some of the engineering problems you'll face after graduation will involve bearing applications. For help in learning more about bearings, write for the 270-page General Information Manual on Timken bearings. And for information about the excellent job opportunities at the Timken Company, write for a copy of "This Is Timken". The Timken Roller Bearing Company, Canton 6, Ohio.

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BEARING TAKES RADIAL ⟠ AND THRUST ⊸ LOADS OR ANY COMBINATION ✳

Technibriefs

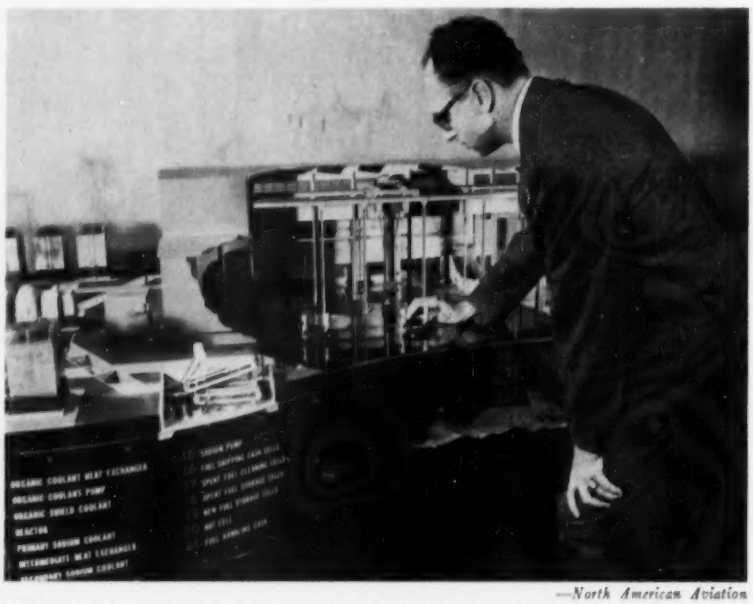
North American Builds Reactor For Power

The first non-military atomic energy reactor to produce power for the generation of electricity by a private utility will be the sodium-graphite reactor now being built by the Atomics International Division of North American Aviation, Inc.

Negotiations are underway between Atomics International and the Southern California Edison Company for the "sale" of surplus heat from the reactor located in the Susana Mountain about 30 miles northwest of Los Angeles.

The sodium-graphite pilot plant reactor will be completed this year. Producing 20,000 kilowatts of heat, the reactor is part of the AEC's five year program to develop economical electricity from atomic energy. Atomics International is contributing $2,500,000 to the reactor project in a joint participation program with the AEC for nuclear power development.

The new agreement, when finallized, will permit Southern California Edison to design, construct, and operate, at no cost to the government, a heat exchanger and turbogenerator with an electrical capacity of about 7,500 kilowatts. Edison's investment in the electrical generating equipment will be over $1,000,000. Electricity from the reactor will be fed over Edison lines to the Santa Susana area in the summer of 1956.



—North American Aviation

Model of sodium graphite power reactor illustrating how electricity can be produced from atomic energy.

Panoramic X-Ray Machine

A new dental X-ray machine that takes a single panoramic picture of the whole mouth in less than a minute has been developed by the National Bureau of Standards' Dental Research Section in cooperation with the Air Force Dental Services and the USAF School of Aviation Medicine.

The panoramic X-ray machine should be particularly useful to the armed forces in making dental surveys of personnel who enter and leave the service. At the present time it takes about 20 minutes for a dentist to make a full-mouth survey because 14 small films are exposed separately. A dentist using the panoramic machine can make the survey in less than five minutes.

Super-Sonic Dust Detector

A highly sensitive dust-recording instrument, believed to be the fastest of its kind, has been developed in Kodak Research Laboratories as part of the company's continual campaign for purity of air in film manufacturing.

The new instrument is so fast it gives an accurate measure of dust conditions within seconds. It also provides a continuous record of dust levels.

It is sensitive enough so that if a few thousandths of an inch of fine dust on the head of a pencil are dispersed through an average room, 8 by 10 by 15 feet, the recorder will detect its presence.

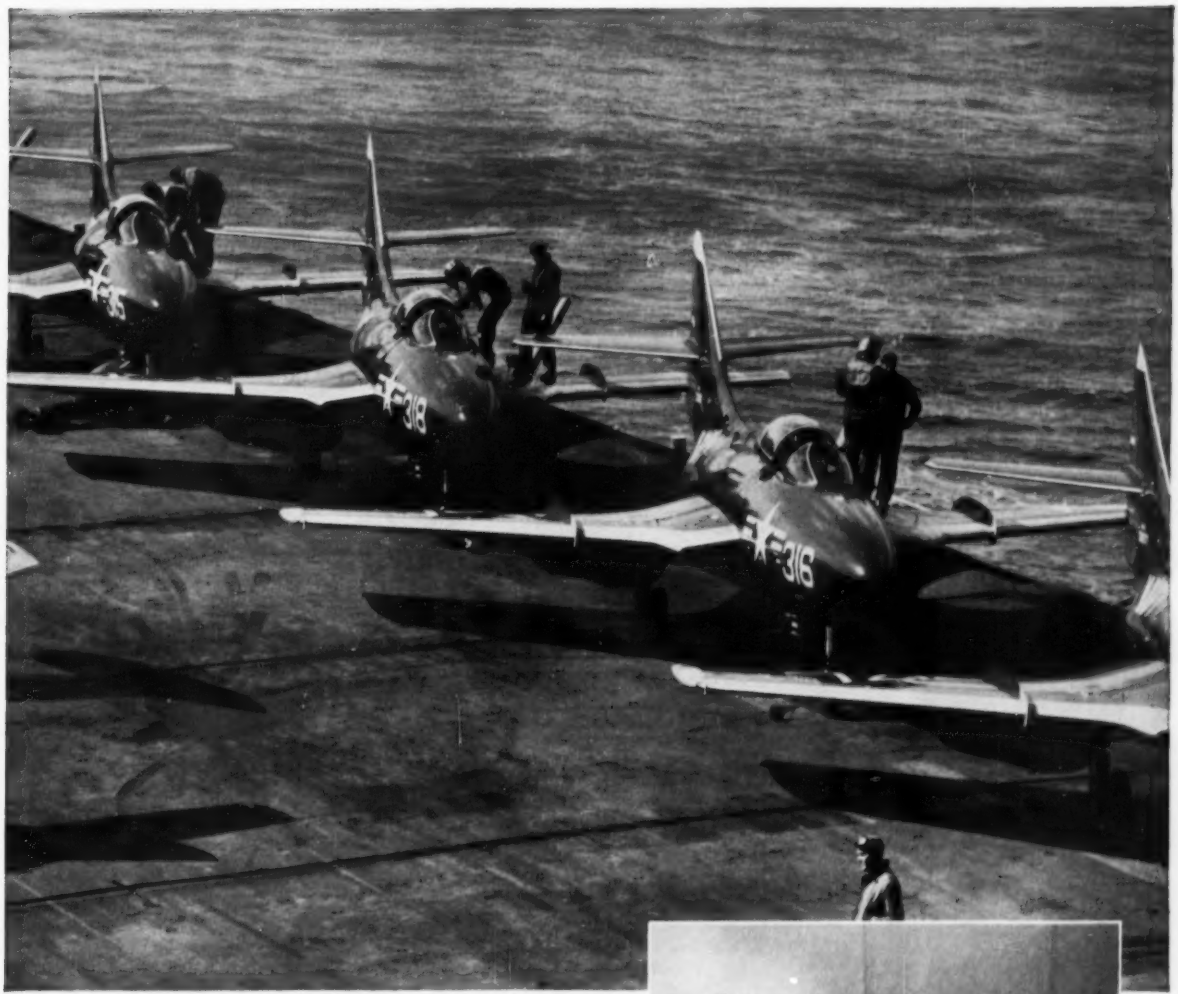
The instrument has a general resemblance to a vacuum cleaner for household use. But, unlike the cleaner, the dust recorder sucks in air through a narrow tube and blows it at supersonic speed against a thin plastic sheet.

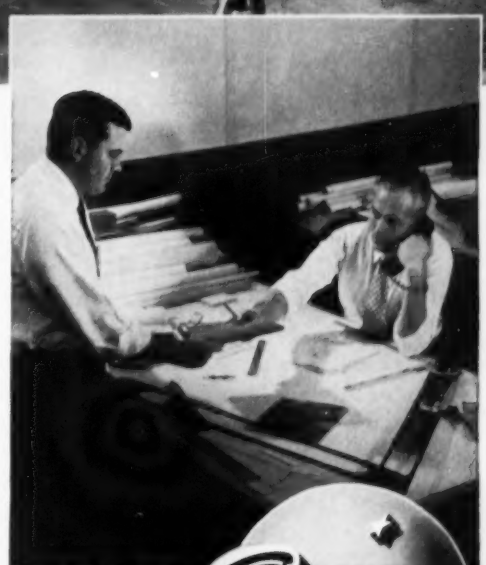
Dust in the air is deposited in a narrow strip on the plastic sheet. Then a photoelectric "eye" reads the dust track for instrument measurement of its density. The resultant record of the dust level is traced on graph paper for a permanent record.

Charles A. Morrison, head of the instrument section of Kodak Research Laboratories' physics division, where the dust recorder was developed, said that the device is also fitted with a microscope.

With this additional attachment, a scientist can also make a swift examination of the dust trail by eye. He can make a preliminary judgment, for example, as to

(Continued on page 44)





NO PAPER PLANES FROM GRUMMAN ENGINEERS

Grumman engineers design airplanes as much for speed of production as for speed and performance. In World War II, Grumman broke 11 World Production Records. During the Korean Conflict, Grumman produced and delivered 8 Panther jet fighters for every jet delivered to the Navy by all other aircraft companies combined. This Grumman design for production applies even to experimental aircraft. Tiger was designed, engineered, and the prototype built, plus the necessary 30,000 tools and fixtures, in only 15 months.

★

To learn more about the interesting role of engineers at Grumman, write for your copy of: ENGINEERING FOR PRODUCTION.

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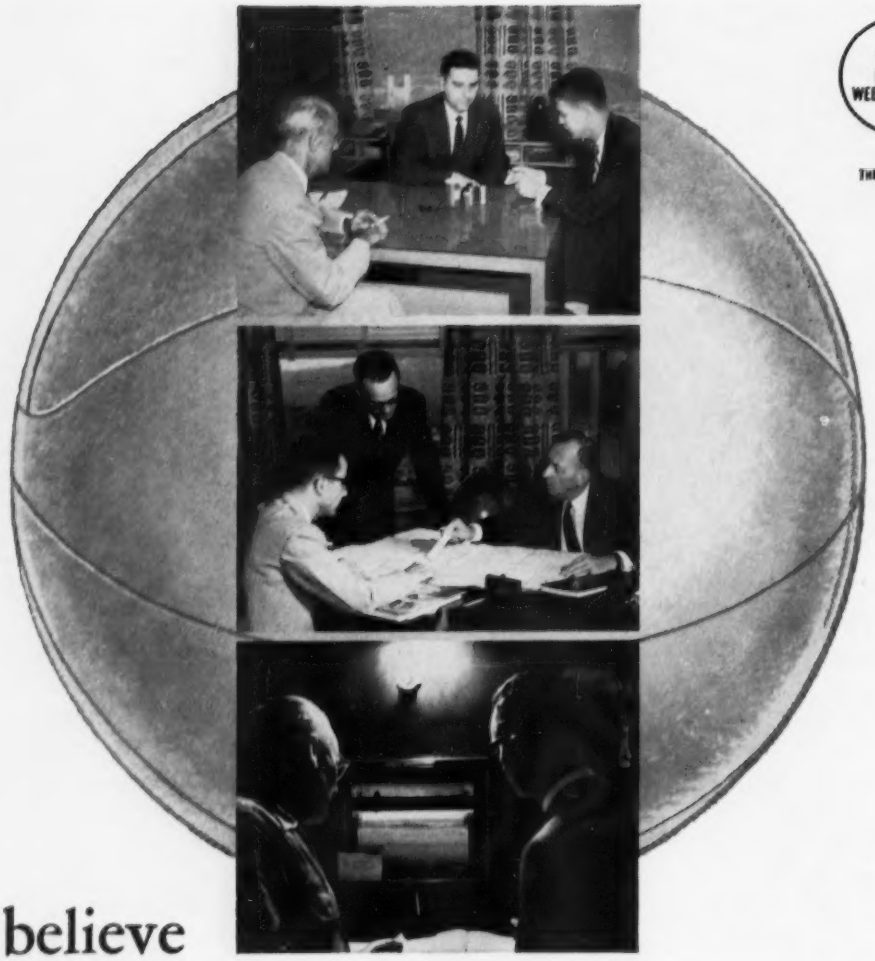

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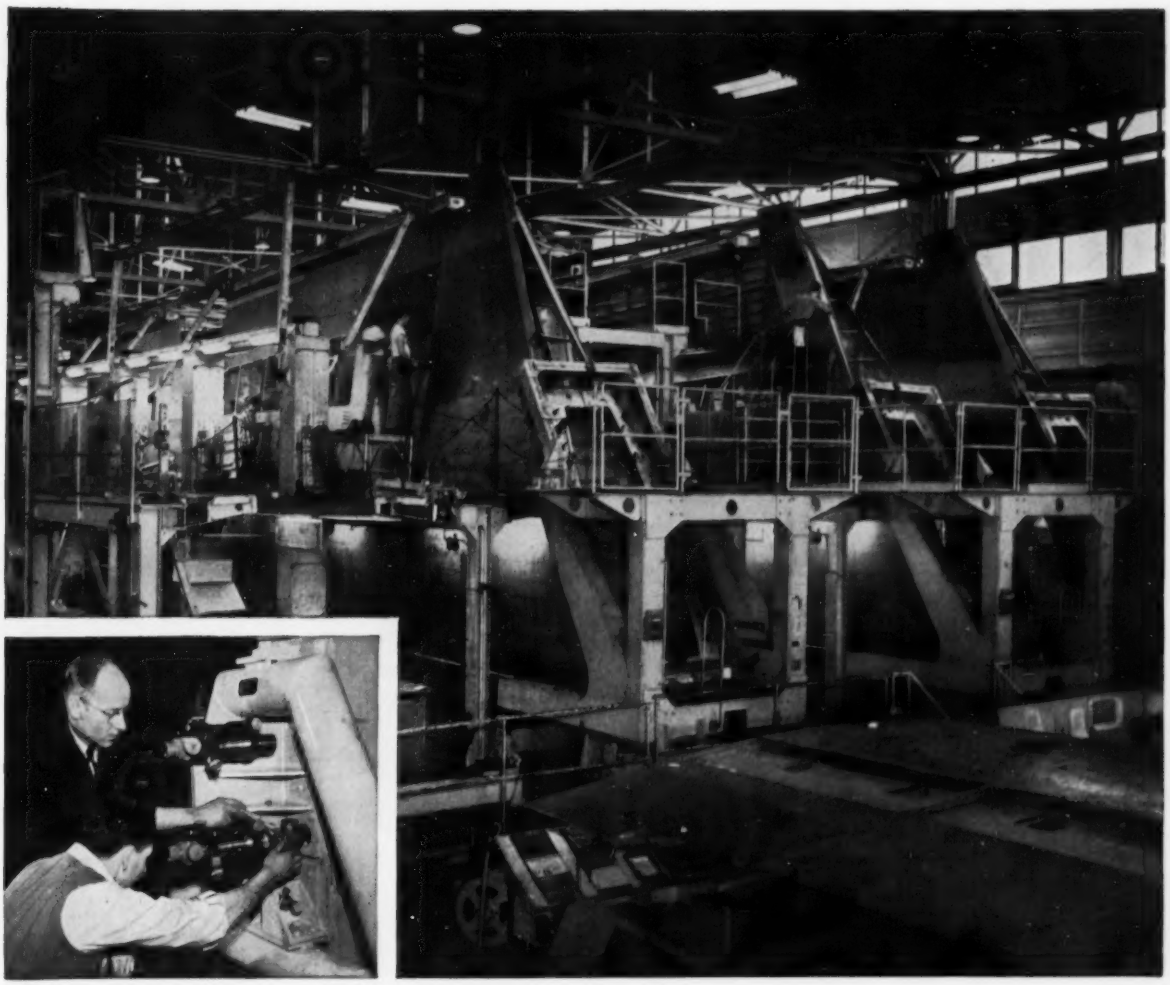

Boeing production engineering—precision on a big scale

This Boeing B-52 wing jig is one of a battery of four. Each one is 90 feet long and weighs more than 1,000 tons. Yet many of its tolerances are within 1/1000 of an inch — as close as a fine watch! Almost-absolute accuracy on a tremendous scale like this means that Boeing production engineers face some of the most stimulating challenges in engineering today.

These production engineers are of many types. And, because of steady expansion, Boeing needs more of them: industrial, civil, mechanical, electrical and aeronautical engineers.

There is "growing room" for topnotch production engineers at Boeing's Wichita and Seattle plants. Big programs are now under way on the airplanes and guided missiles of a few years hence. And Boeing production engineers are responsible for the high quality and continuous development of such industry-leading airplanes as the B-52 — famous "Long Rifle" of Strategic Air Command — and the 707 — the world's first jet tanker-transport.

At Boeing, production engineers find individual recognition in tightly integrated teams in design-analysis, test, and liaison-service. They find that Boeing is an "engineers' company," with a long-standing policy of promotions from within the organization.

Career stability and growth are exceptional at Boeing, which now employs more than twice as many engineers as at the peak of World War II. Boeing engineers enjoy a most liberal retirement plan. And life for them is pleasant in the progressive, "just right" size communities of Seattle and Wichita.

There are opportunities at Boeing in design and research, as well as in production. If you want job security, satisfaction and growth, it will pay you to investigate a Boeing career *today*.

For further Boeing career information consult your Placement Office or write to either:

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Boeing Airplane Company, Seattle 14, Wash.

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If you are an ELECTRICAL ENGINEER, MECHANICAL ENGINEER or PHYSICIST, contact Motorola today.

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Contact your Placement Officer for further information regarding interview time, place and date, or write to:

MOTOROLA Engineering Recruitment Office
4501 Augusta Blvd. • Chicago 51, Ill.

Technibriefs

(Continued from page 40)

whether the magnified dust is lint or metallic in origin. More complete chemical or microscopic analysis of the dust can be made later over a period of several hours by regular laboratory methods.

The dust recorder proves useful also to check the effectiveness of air filtering systems. Samples of air taken ahead of the filters and behind the filters in a system quickly indicate on the dust recorder how much the filters are removing from the circulating air.

One early finding with the new equipment is something long suspected by engineers and some housewives. This is that sometimes the dust level tends to rise in the area of a clean-up effort and may then subside to the same rather than to a lower level.

Two-Part Tube Fittings

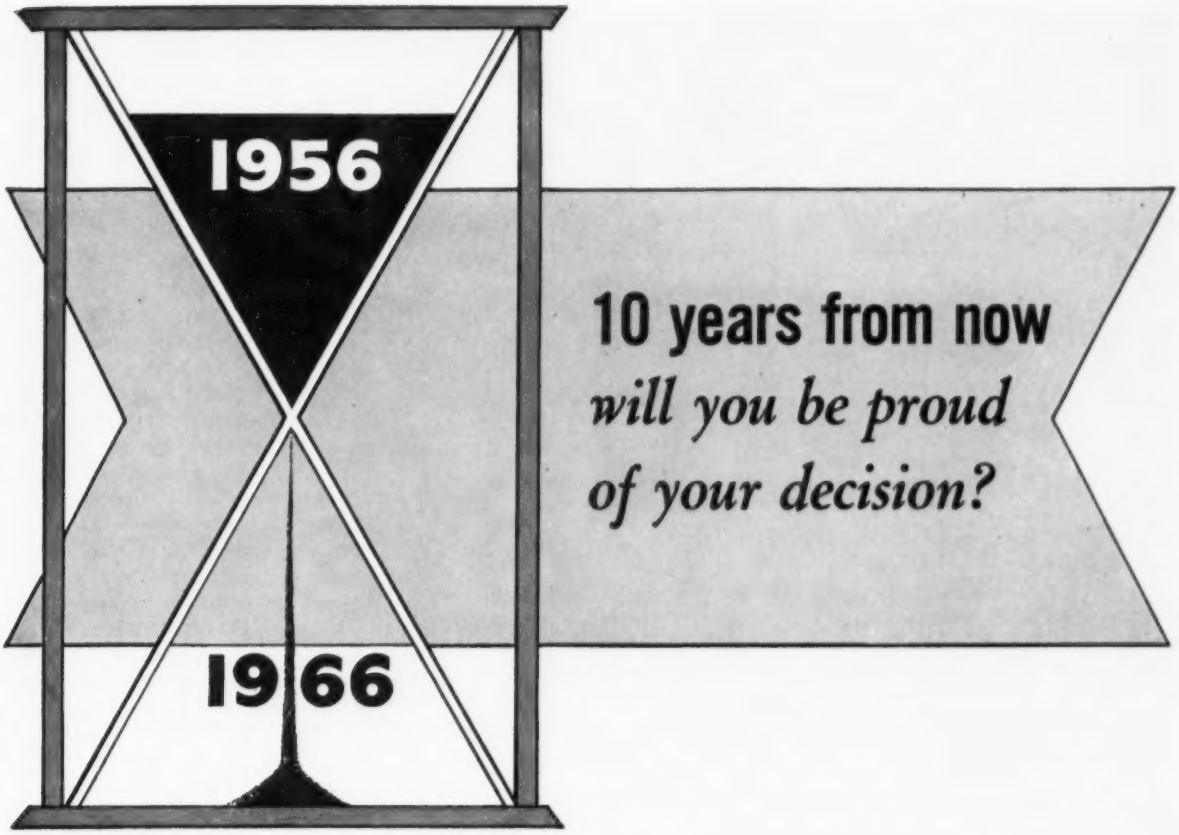
A simplified line of tube fittings which consists of two parts instead of the conventional three, requires no flaring of the tube, and permits re-use of the tubing, has been made using Du Pont's "Zytel" nylon resin.

This simplification is made possible by incorporating the compression section as an integral part of the nut. The fittings, which can be used with any type of tubing, metal or plastic, are available for tubing with outside diameters ranging from one-quarter through one-half inch. Pipe sizes run from one-eighth to one-half inch.

The design of these fittings does not require tubes cut to exact lengths. Leak-proof connections can be made without indenting or "necking" the tubing, thus, both fitting and tubes can be re-used. Further simplicity in assembly is achieved since every joint is a union.

These "Jaco" fittings have been submitted to standard vibration tests and have gone to well over 22 million cycles with no fracture occurring. Burst strength of the fittings is well in excess of that required for the tubes for which

(Continued on page 46)



The right decision now, at the launching of your career, can do much to influence your success.

Pittsburgh Plate Glass Company has a host of fine young men who are holding responsible positions in the PPG organization. Ten years ago, many of them were faced with the same decision that now faces you: "Which company shall I select?"

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This is your year of decision. We invite you to look into Pittsburgh Plate Glass Company. To help you become better acquainted with PPG, we suggest you get a copy right away of the booklet entitled, "Toward New Horizons with Pittsburgh Plate." Ask your placement officer for a copy or write directly to the Pittsburgh Plate Glass Company, General Personnel Director, One Gateway Center, Pittsburgh 22, Pennsylvania.

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345 PLANTS, MERCHANDISING BRANCHES, AND SALES OFFICES LOCATED IN 250 CITIES

Technibriefs

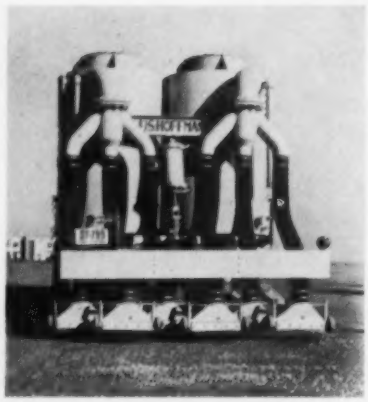
(Continued from page 44)

they are intended. Because "Zytel" is a non-conductor, the danger of electrolytic corrosion at joints is eliminated.

Giant Vacuum Cleaner

A giant vacuum cleaner, said to be the world's largest, was demonstrated recently at Anacostia Naval Air Station, Washington, D. C. for Defense Department officials. Dubbed the "Jarc" (Jet Aircraft Runway Cleaner) by its manufacturer, the U. S. Hoffman Machinery Corporation, this huge mobile vacuum cleaner is specificially designed for use on airfield runways handling jet aircraft operations. The new unit is expected to make an appreciable reduction in engine damage and maintenance figures recorded as a result of foreign material being "sucked-in" through jet air-scoops.

Weighing about 30,000 pounds and about 30 feet in length, the



—*Hepperstall Co.*

Rear view of the world's largest vacuum cleaner, the "JARC".

"Jarc" is able to clean and remove all debris from a two-million square foot area in about eight hours. The vacuum cleaning equipment is mounted on a specially-designed truck body. Two heavy-duty industrial exhausters provide suction for the vacuum system and they possess the energy equivalent of 1200 home-type cleaners.

The actual vacuum surface is made up of six ground-level nozzles, arranged over an eight-foot width at the rear of the vehicle, which suck in air at the rate of 350 mph. When the nozzles are not in use, they are pneumatically raised to a "stand-by" position. Each nozzle is equipped with two small wheels on which it rolls along on the runway surface. Material removed by the cleaning nozzles from the runway is carried through pipes to the unit's material collectors. Each collector is fitted with a special hinged door for removing the material after cleaning operations are completed.

The "Jarc", which uses "air-vacuum power", will pick up anything from paper and cloth to ferrous and non-ferrous metals. This advancement in cleaning was graphically demonstrated during the showing, as the "Jarc" thoroughly and completely cleaned an area littered with steel, aluminum, sand, gravel, paper, wood, and a variety of other materials.

(Continued on page 50)

Special Interest Books
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Special Prices

The Physical Nature of Flight
by Holland
$1.49 (was $4.00)

American Locomotives—by Alexander
A Pictorial Record of Steam Power, 1900-1950
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The History of the American Sailing Navy
by Chapelle
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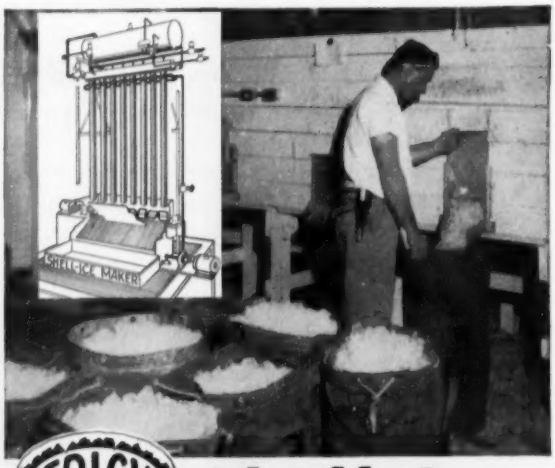

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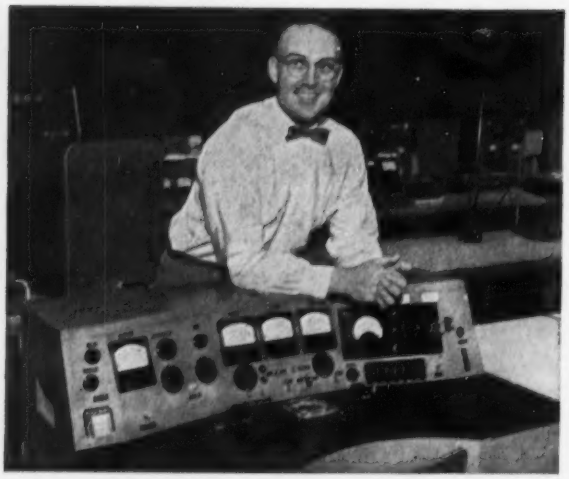
Warehouse stocks of A-L Stainless carried by all Ryerson plants

AL
LEADING PRODUCER
HIGH-ALLOY STEELS

WSW 6004

Young engineers making news at Western Electric



Richard C. Shafer, B.S. in mechanical engineering at Lehigh, was one of 16 engineers assigned to one of Western Electric's toughest post-war projects — developing manufacturing techniques for mass-producing *(with great precision!)* the tiny but amazing transistors which are already causing a revolution in electronics.

Western Electric's primary job — which goes 'way back to 1882 — is to make good telephone equipment that helps Bell telephone companies provide good service. It's a very big job — and a very important one — which calls for the pooling of varied types of engineering skills.

New manufacturing processes and methods are constantly required to produce better telephones, better central office equipment, better wires and cables, new types of electronic equipment to keep pace with the nation's ever-growing need for more and better telephone service at low cost.

In addition to doing our job as manufacturing unit of the Bell Telephone System, Western Electric is busy producing many types of electronic equipment for the Armed Forces. Here again, young engineers of varied training are doing important work in connection with the manufacture of radar fire control systems, guided missile systems and special military communications systems.

Paul J. Gebhard, B.S. M.E. at the University of Maryland, was one of a team that helped develop Western's new electroforming process for coating steel telephone wire with copper, lead and brass in one continuous operation. His job: to develop conductor resistance-annealing equipment and electrolyte filtration and circulating systems.

Bobby L. Pettit (at right), an E.E. from Texas A. & M., is one of several hundred members of Western Electric's Field Engineering Force. These F.E.F. men can be found all over the world — working most closely with the Army, Navy and Air Force — advising on the installation, operation and maintenance of complex electronic equipment made by W.E.

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Allied's chemicals in some way enter into nearly every manufactured product in America's homes, farms and factories. In all, Allied has *seven* producing Divisions—and the list of its 3,000 products is still growing. Seen or unseen, they're making life easier, more pleasant, more *modern*.

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The Annual Report gives a comprehensive account of the Company's progress in 1955. We'll be glad to send a copy on request.

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An engineering writer is that rare combination of a man so technically informed that he knows every detail of a given piece of equipment—and also is able to present a clear, concise, written description of its operation and performance.

Engineering writers at Hughes are as important to the team effort on any project as the other engineers and physicists with whom they work in close cooperation. This is because the material created by engineering writers are *products*—just as are antennas, modulators, synchronizers and other electronic items.

The writers' products include Hughes equipment operating instructions; pilot and radar operator instruction manuals; service instruction books; test equipment use and service manuals; illustrated parts catalogues. Tape recorders are a time- and effort-saving tool in this work.

Evening classes are available nearby at the University of California, Los Angeles, and the University of Southern California, for engineering writers desiring to advance their knowledge of the electronics arts.

ENGINEERS and PHYSICISTS

FOR INFORMATION CONCERNING AVAILABLE POSITIONS WRITE:

Scientific Staff Relations

HUGHES

RESEARCH AND DEVELOPMENT LABORATORIES

Culver City, Los Angeles County, California

Photo, above: Engineering writer working with Hughes engineers on a design phase of the Hughes Falcon air-to-air guided missile.

Technibriefs

(Continued from page 46)

Radioactive Fallout Computer

A new electronic computer has been designed that can calculate in one twentieth of a second the fallout pattern from a nuclear detonation.

The computer was developed at the suggestion of the U. S. Weather Bureau and supported by the Atomic Energy Commission. Given the wind speed, direction, and details about the bomb, the computer displays on a TV-like screen the fallout pattern within a 250-mile area.

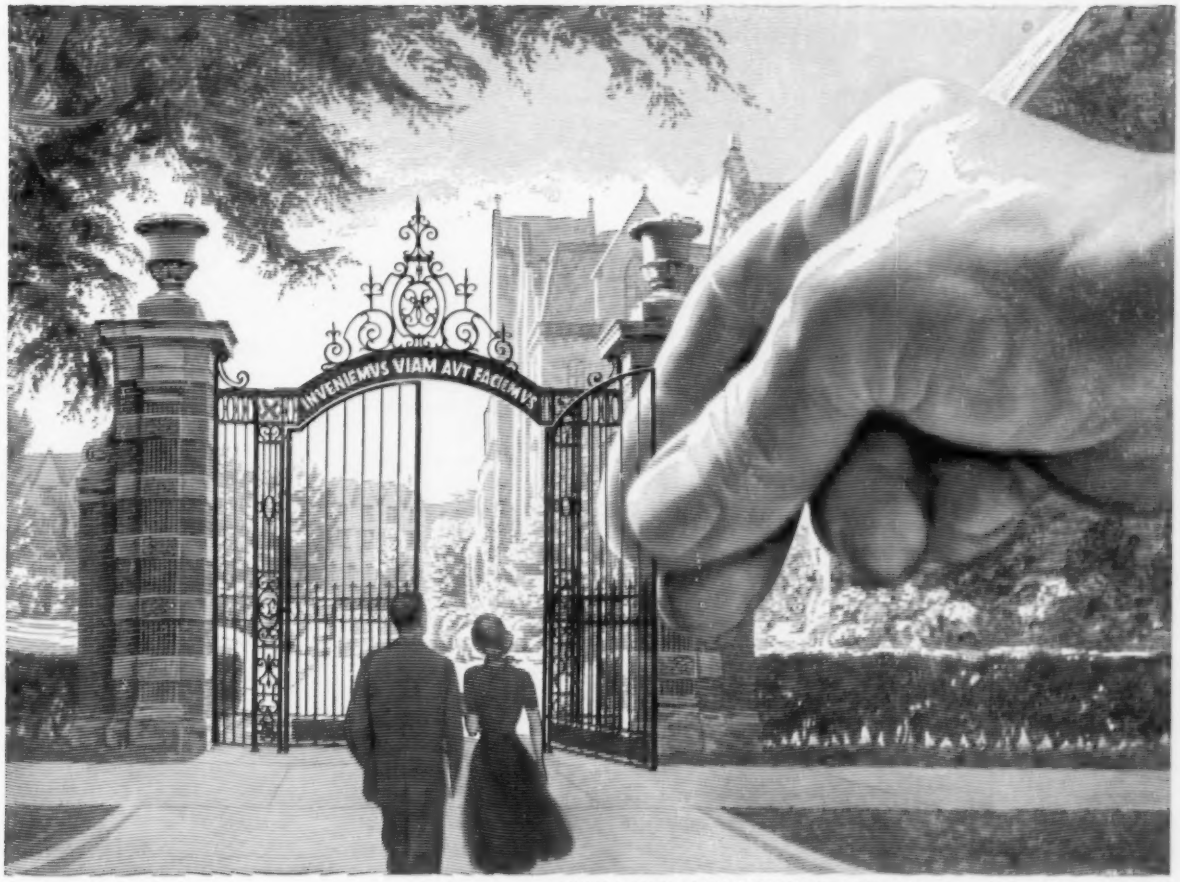
The computer will be used by the AEC at its atomic proving grounds to assist in providing extra safety during bomb tests. It may also become useful for civil defense since its cost in production is expected to be under $10,000.

Ag Engineers

(Continued from page 17)

Agriculture students each term, the department sponsors a five year curriculum, in conjunction with the College of Engineering, in agricultural engineering. Although only 31 students are enrolled in all five years of the program at present, this represents but the third year of the plan's operation. Professor O. C. French, director since 1947, believes that the increasing number of applications points toward an increased enrollment in the next few years.

With increasing farm mechanization, there will be expanding opportunities for agricultural engineers. At present they are active in the following applications of engineering to agriculture: (1) power and machinery, (2) soil and water management, (3) agricultural processing, (4) rural electrification, and (5) farm structures. The future will probably witness this list greatly extended, and the number of agricultural engineers enlarged.



INVENIEMUS VIAM AUT FACIEMUS: "We shall find a way or we shall make one."
—Memorial Gate, University of Pennsylvania

Investing in young America . . . a progress report

"To HELP deserving young men and women obtain a college education . . . to give financial support to a cross-section of American colleges . . ."

FOUR YEARS AGO, the Union Carbide Scholarship Plan was established with those objectives.

Today, the plan provides the complete cost of tuition and fees for 400 four-year scholarships at colleges and universities throughout the country. As an important part of their education, the scholars are encouraged to gain valuable experience in their chosen fields by obtaining jobs in industry during summer vacation.

50 TECHNICAL SCHOLARSHIPS are also available in specific fields of study. They cover the student's tuition and fees for the senior year. In addition, to assist graduate students and to support academic research, Union Carbide offers 66 fellowships and grants-in-aid to universities.

THE PEOPLE OF UNION CARBIDE regard these scholarships as an important contribution to the future and to two of America's priceless assets—its educational system . . . and its youth.

TO LEARN MORE *about the Union Carbide undergraduate scholarships and the colleges and universities in which they have been established, write for Scholarship Plan booklet X.*

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A Division of International Telephone and Telegraph Corporation
500 Washington Avenue, Nutley, N. J.

Professor Dropkin

(Continued from page 18)

were also established so the temperature of the room could be adjusted from 30°F. to 100°F. Inside the constant temperature room was built a smaller room, similar to a room in a house. Inside the inner room were put various types of heaters and radiators whose heating ability were to be tested. The outside conditions were adjusted to the desired temperature and wind velocity. The apparatus to be tested was then set in operation and tested under conditions very similar to those under which it would be used.

At some temperatures either no one or everyone is comfortable, while at other temperatures different people are affected different ways. Authorities have realized for some time that there are two factors affecting the comfort of people: actual physical discomfort and psychologically caused discomfort. About 1940 Professor Dropkin and some members of the psychology department decided to start research in this department to try to find the temperature range under which most people are comfortable. At this time the United States was drawn into World War II and the experiment was abandoned. The Army took over the constant temperature room for their research and the experiment has never been revived.

Professor Dropkin's research and testing have extended into a variety of industries. He worked for the Utica Radiator Company testing boilers, radiators, and valves. He worked for E. I. DuPont finding thermal conductivities of plastics. His research and testing experience has extended even to testing the power transmission in a fluid clutch and testing a water pump for the Elmira Water Board.

For most of his research and testing, Professor Dropkin has to design his own apparatus and often he uses this same apparatus in classes. A notable example of this is an electric analog he used at Brookhaven National Laboratory to study two dimensional heat transfer. After using the equipment at Brookhaven, he used it in his lectures to show methods of solving complicated heat problems. Other apparatus he has found it necessary to design is equipment to make psychometric measurements for some extensive research he did in that field. Psychometry is the measuring of humidity with wet and dry bulb thermometers. When he published a report on his research, Professor Dropkin received requests for copies of his report from as far away as India, Japan, and Russia.

For his work in the field of heat transfer research, Professor Dropkin has been elected to several societies and honorary fraternities: Sigma Xi; Pi Tau Sigma—Mechanical Engineering honorary fraternity; Tau Beta Pi; and Atmos—Mechanical Engineering honorary fraternity at Cornell. He is also a member of American Society of Heating and Air-Conditioning Engineers, American Society for Engineering Education, American Association of University Professors, and Society of Cornell Engineers.

College News

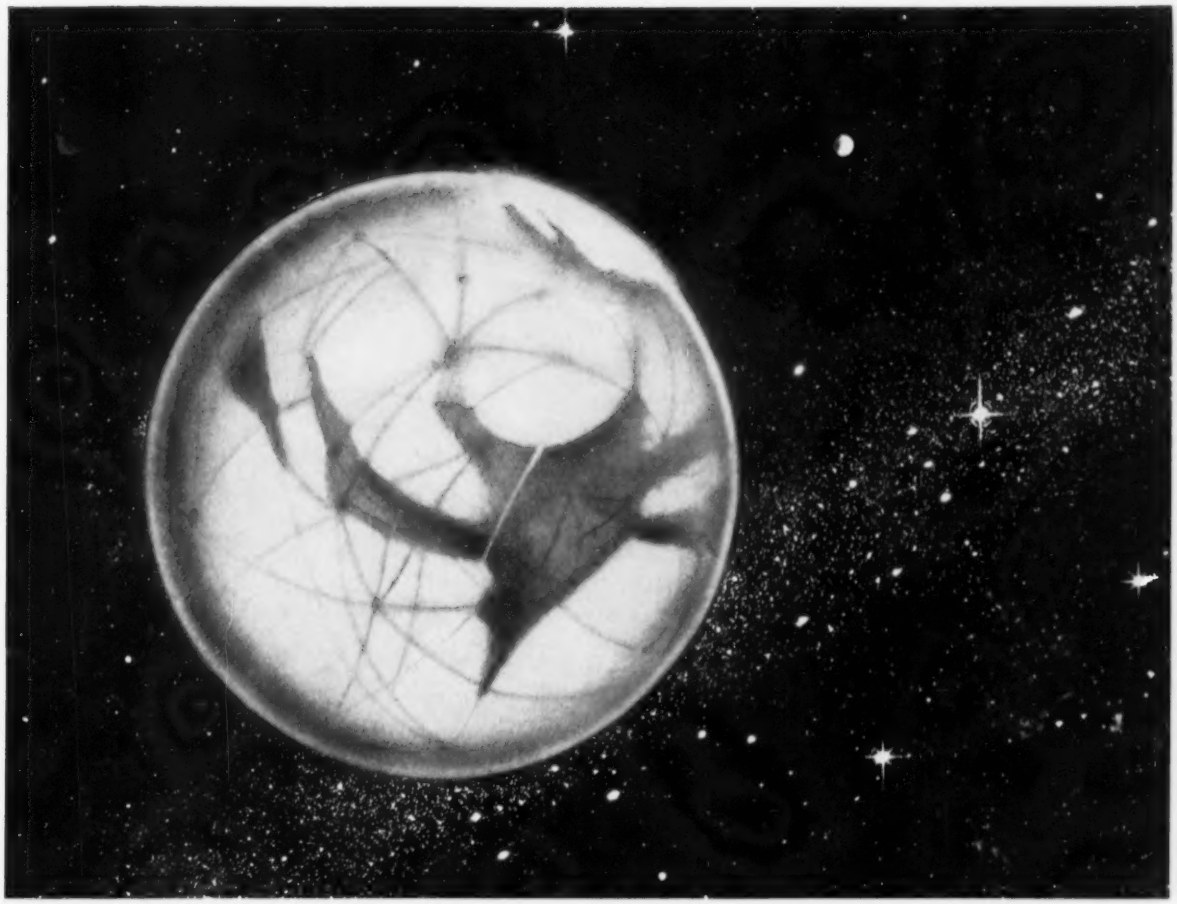
(Continued from page 32)

The fellowship awards are one phase of the General Electric educational support program which this year will disburse approximately $1,250,000 according to Kenneth G. Patrick, G-E manager of educational relations.

The fellowships range from a minimum of $1,750 for a Fellow who is single to $2,100 for a married Fellow without children, to $2,500 for a married Fellow with children. In addition, a grant of $1,200 is made for each Fellowship to the university at which the Fellow will study. This grant is applicable to tuition, equipment and other educational costs.

The General Electric Fellowships were awarded to universities in the United States which nominated the recipients of the grants. In the case of the previous group of 34 fellowships, selection was made by a committee of six representatives of national professional societies,

(Continued on page 56)



Bendix LUMICON—*more detail-sensitive than the human eye*—to explore Mars' mysteries

Light amplifier to be used in medicine, industry, astronomy

Long considered the most sensitive optical instrument ever created, the human eye at last has a competitor! Lumicon, developed by engineers of Friez Instrument Division of Bendix Aviation Corporation at Baltimore, Md., is far more effective than the human eye under certain circumstances. For the eye's major shortcoming is its inability to resolve objects satisfactorily under failing light conditions. For that reason, scientists have sought for many years to devise an electronic "eye" which will enable us to "see in the dark", that is, to see fine detail at light levels far below those at which the human eye can do so. Bendix* Lumicon is that instrument.

Lumicon amplifies light as much as 50,000 times to produce, on a television screen, bright-as-day images of objects in "total darkness" which are invisible to the unaided human eye.

In astronomy, Lumicon promises to help unravel many of the secrets of the Solar System. This summer, when Mars is closest to the Earth, a team of scientists will take Lumicon to Africa in the hope of making more detailed observations of this fascinating planet than have ever been possible before. Does the Red Planet support life? What about the fabled "canals" so far unresolved in telescopic photographs of Mars? We may have to wait a while to learn the final answers to these ancient questions—but early observations using Lumicon indicate that it will bring us far closer to a solution than we might have dreamed a few short years ago.

Originally conceived as a medical tool, Lumicon is a real boon to the medical profession in amplifying weak fluoroscopic X-ray images. Expansion of such techniques promises earlier and better diagnosis, as well as easier and more effective observation of the progress of treatment in internal ailments.

In industry, too, Lumicon has many applications. For example, it will make possible "live" instantaneous X-ray fluoroscopic images of forgings, castings, and structures such as major aircraft parts—and detect fatigue and incipient failures which would have been missed by the slow, old-fashioned X-ray photographic methods.

Lumicon is merely the latest in a long succession of products which typify the never-ending search at Bendix for ingenious and important contributions to American science and industry. It's one more reason why talented young engineers find it exciting and stimulating to work for Bendix.

At Bendix you enjoy the opportunity offered only by a large corporation; yet the 26 individual divisions are small enough so that an engineer of promise cannot be overlooked. Producing over a thousand different products for every phase of industry, Bendix deserves your attention when you plan your future. See your placement director or send for the brochure "Bendix And Your Future."

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Bendix

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Ocean Laboratory—here at its big Kure Beach, N. C., Testing Station, Inco exposes thousands of metal specimens to the corrosive effects of salt spray, salt air, salt water.

How International Nickel finds out what the wild waves are saying

How hard can the sea bite? This is no secret to Inco Corrosion Engineers. For over thirty years, they have been collecting data on the corrosive and erosive effects of sea water on many different kinds of metal.

In Inco's "Ocean Test Tube" and associated laboratories, Inco Corrosion Engineers have the facilities and apparatus to study all phases of marine and atmospheric corrosion.

The sea's a killer of many metals. Some it corrodes or rusts. Some it wears away. Some it destroys by eating up one of the alloying elements. Some it makes so "allergic" to connecting metals that corrosion is speeded up.

To hunt this killer down, International Nickel has made the ocean into a test tube. At Harbor Island and Kure Beach, North Carolina. Here, Inco Corrosion Engineers study the corrosive effects of salt water, salt spray, salt air, water velocity, marine growths, coupling methods.

To help you plan Inco Nickel into your future, International Nickel Company has collected data from almost a quarter of a million individual tests on the behavior of metals and various other materials under all sorts of corrosive conditions.

"Corrosion in Action" is an Inco-prepared film in full color. It shows how corrosion acts and how it can be controlled. Prints loaned to engineering classes and student technical societies. Write, The International Nickel Company, Inc., Dept. 126e, New York 5, N. Y.

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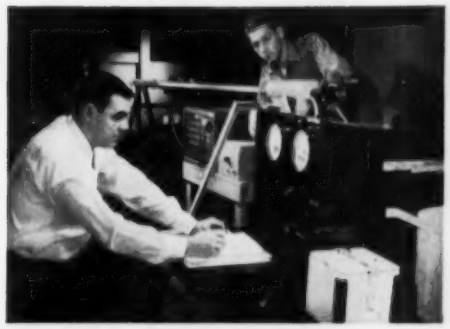
INCO TRADE MARK **International Nickel**

Producer of Inco Nickel, Nickel Alloys, Copper, Cobalt, Tellurium, Selenium and Platinum, Palladium and Other Precious Metals

Electronics Research Engineer Irving Aine records radiation antenna patterns on Lockheed's Radar Range. Twenty-two foot plastic tower in background minimizes ground reflections, approximates free space. Pattern integrator, high gain amplifier, square root amplifier and logarithmic amplifier shown in picture are of Lockheed design.



Mechanical Research Engineer W. M. Watkins (left) directs Research Mechanic Earl Rollo in operating Lockheed's new Hailstone Gun during a test on the effect of hailstones on new types of plastic radome "skin." The gun, which was designed by Watkins and Mechanisms Group Engineer G. W. Louthan, fires up to five hailstones spaced 25 feet apart at speeds ranging from 270 to 500 mph. The hailstones, which are made in the gun, can be varied in size from $\frac{3}{8}$" in diameter.

Research Engineer Russell Lowe measures dynamic strain applied by Lockheed's 500,000 lb. Force Fatigue Machine on test specimen of integrally-stiffened Super Constellation skin. The Fatigue Machine gives Structures Department engineers a significant advantage in simulating effect of flight loads on a structure. Among other Lockheed structures facilities are the only shimmy tower in private industry and largest drop test tower in the nation.

C. H. Fish, design engineer assigned to Lockheed's Icing Research Tunnel, measures impingement limits of ice on C-130 wing section. The tunnel has a temperature range of −40°F. to +150°F. and maximum speed of more than 270 mph. It is the only icing research tunnel in private industry.

Advanced facilities speed Lockheed engineering progress

Lockheed's unmatched research and production facilities help make possible *diversified* activities in virtually all phases of aviation, military and commercial.

They enable engineers to test advanced ideas which would remain only a conversation topic in firms lacking Lockheed's facilities. They help give designers full rein to their imagination. They make better planes – and better careers.

Engineering students interested in more information on Lockheed's advanced facilities are invited to write E. W. Des Lauriers, Lockheed Student Information Service, Burbank, California.

Lockheed

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WHY CERTAIN DESIGNS SUCCEED

an idea to help you advance faster

SUCCESSFUL designers state that costs are the most important factor in the success of any product development today. Manufacturers recognize this and, as a result, seek out the engineers who are cost minded.

Industry's stress on lower costs comes from the increasing competition for buyers. Rising costs of materials and labor must be offset by good designs to keep selling prices down to realize a profit from sales.

Ingenious use of materials is the best way you can eliminate needless expense in manufacture. By using steel as the basic material and welding for fabrication, you have a decided advantage in saving money for a manufacturing company . . . and getting your designs accepted.

Cast Construction — Costs $28.13

Welded Steel Construction — Costs $6.49

Results from using welded steel instead of gray iron are shown in the above design comparison of a typical bracket used on modern machinery. The cast bracket costs $28.13. The welded steel bracket costs $6.49, weighs 65% less, yet is stronger and more rigid than the cast design.

Similar savings are possible in many types of mechanical parts. Therefore, it will pay you to know how to utilize steel. Why not write us for latest design bulletins.

THE LINCOLN ELECTRIC COMPANY
Cleveland 17, Ohio
The World's Largest Manufacturer of Arc Welding Equipment

College News

(Continued from page 52)

two college presidents, and two G-E representatives.

Recipients of the General Electric Fellowships to Cornell, their undergraduate schools, and fields of study are:

Karl Berkelman, 340 College St., Lewiston, Maine, University of Rochester, physics.

Stephen R. Cohen, 502 Dryden Road, Ithaca, N. Y., Cornell University, chemistry.

Roger G. Ketcham, 245 Veterans Place, Ithaca, N. Y., Antioch College, chemistry.

ASME Meetings

Mr. T. L. Leininger of E. I. du Pont de Nemours and Company spoke on "Computers and Their Applications" at the meeting of the Cornell Chapter of American Institute of Chemical Engineers in Olin Hall, February 24.

Mr. Leininger stressed the expanding role of digital computers in obtaining rapid, accurate solutions to many types of engineering problems. The outstanding feature of these machines is the speed with which they assimilate, analyze, and correlate large masses of data.

Brinton S. Deighton, Jr. was presented with the AIChemE award for outstanding scholastic achievement during his freshman and sophomore years. Mort Friedman, chairman of the School of Chemical Engineering for Engineers' Day, spoke to members about exhibits and projects for the coming event. Candidates for the Fuertes Memorial Contest in public speaking were reminded to have their preliminary talk and paper ready before April 4.

The guest speaker for the American Society of Mechanical Engineers' meeting on February 29 was Mr. Robert Hammon of Sperry Gyroscope. Mr. Hammon outlined some of the important equations and their solutions which govern "Inertial Navigation". As examples of their application, he discussed two gyrators of the same capacity, one 800 pounds and eight feet high, while the other only 23 pounds and eight inches high.

The April 10th meeting of the ASME will feature Mr. Hoffman of the Philadelphia Electric Company. He will discuss the use of supercritical steam for power generation.

Air Photo Course For Highway Engineers

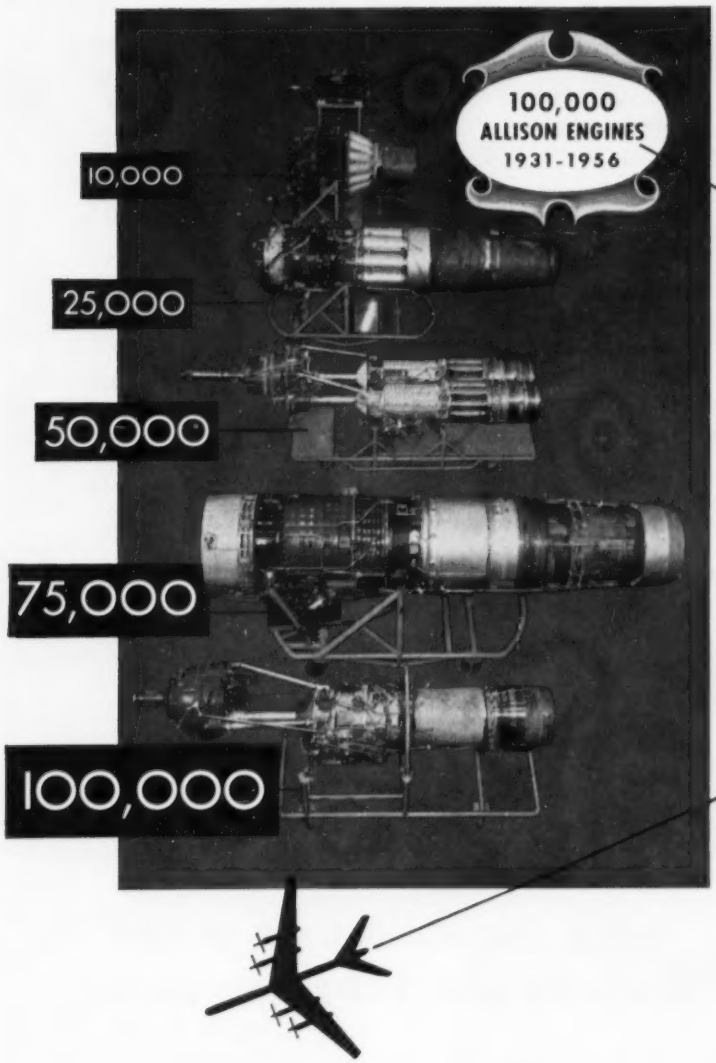
Ten highway engineers from Newfoundland to Washington completed a three week course at Cornell in which they learned to identify earth materials with differing characteristics on airphotos from their areas. The men learned to identify rock and soil types, to locate landslides and granular materials and to plan drainage from stereoscopic airphotos. Then, with help of faculty members they mapped highways based on this information.

It is the first of a series planned by the Airphoto Center in the School of Civil Engineering. Information may be obtained from Professor Theodore Cheney in Lincoln Hall. Airphoto analysis, often faster, easier, cheaper, and more accurate than ground observation, will help make increased highway construction as modern and efficient as possible, according to Professor Cheney.

Books By Professors

Two professors published their writings this term. Professor H. H. Mabie of the Sibley School of Mechanical Engineering is the author of an article in the February 9 issue of Machine Design. The article on "Calculations of Beam Deflection Due to Shear" appears in the magazine's "Data Sheet" section, which is a reference guide for practicing engineers throughout the country.

A book by Dennis G. Shepherd, professor of mechanical engineering in the department of thermal engineering, will be released this spring. The book, "Principles of Turbomachinery" is the first complete text for courses in turbomachinery. Professor Shepherd is the author of another book, "Introduction to the Gas Turbine".



PIONEERING NEVER ENDS AT ALLISON

Today's powerful turbo-jet and turbo-prop engines are a far cry from the aircraft engines of a mere 10 years ago.

But we've hardly scratched the surface. We're still pioneering.

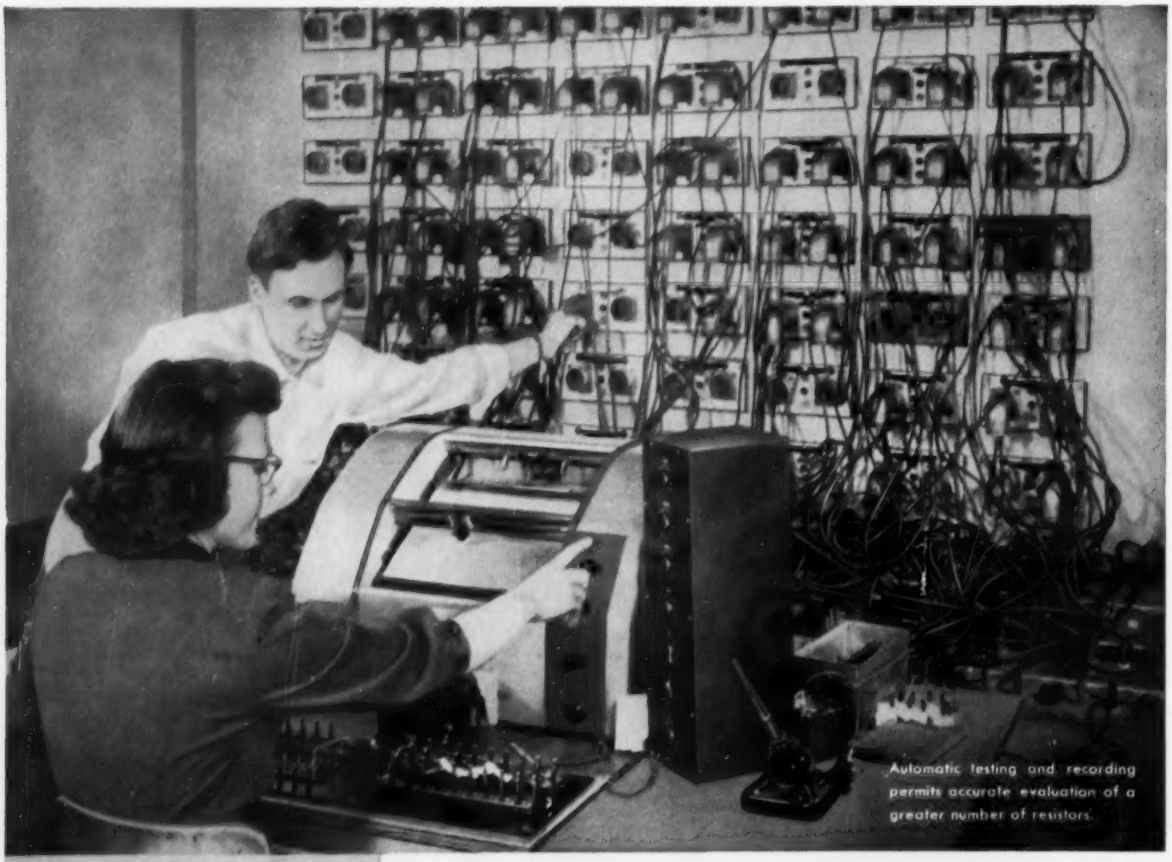
Sure, the sound barrier's been cracked. But, who knows, perhaps in the next 10 years we'll be flying at speeds 2 or 3 times the speed of sound. Newer, more complex, more powerful engines ARE in the offing. There'll be new fields to conquer. For instance, the thermal barrier!

Allison, a pioneer in the design, development and production of aircraft engines, now is working on advanced design turbine engines to meet future requirements . . . whatever they might be. Proven features of engines like the Allison J71 and T56 may be adapted to the engines of tomorrow. Allison engines of the future will be backed up with worlds of experience gained in the development and production of its first 100,000 aircraft engines.

Now, Allison is in the midst of a $75 million expansion program in engineering research and development facilities. Completion of the program will give Allison one of the world's most complete, best-equipped, centers for the development of new, high performance turbo-prop and turbo-jet aircraft engines. This opens new and unlimited opportunities for young graduate engineers, for the program—financed by General Motors—creates an immediate need for a 40% increase in engineers.

☆ ☆ ☆

Want to know more about YOUR career opportunities at Allison? Why not arrange now for an interview with our representative on your campus. Or, write for information about the challenging work awaiting you at Allison: Engineering College Contact, Allison Division, General Motors Corporation, Indianapolis 6, Indiana.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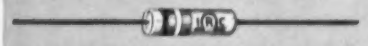
JAN and MIL Specifications are basic guideposts for electronic advancement, whether used as engineering reference points or as procurement standards. IRC's dual emphasis on mass production and exacting testing assures highest performance standards at lowest possible cost.

SPECIFIC EXAMPLES



Type BT Insulated Composition Resistors
MIL-R-11A Specification

IRC Power Wire Wound Resistors
MIL-R-26B Specification

Type BW Low Wattage Wire Wounds
JAN-R-184 Specification

Sealed Precision Voltmeter Multipliers
JAN-R-29 Specification

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. . . another reason why engineers prefer IRC Resistors

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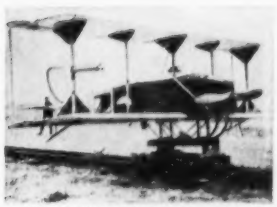

1916 SPERRY "AERIAL TORPEDO," FORERUNNER OF TODAY'S GUIDED MISSILES

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Missile Careers with Sperry

Study the list above and you'll find that here at Sperry we are engaged in every phase of engineering necessary for missile development. Since 1916 when Sperry developed the first pilotless aerial torpedo for the Navy, we have specialized in all the arts required for the missiles of today — and tomorrow. Currently Sperry is putting its capabilities to work in six major missile systems — of all types — ranging from complete systems' cognizance to major sub-system responsibility.

If you are interested in getting into missile engineering or want to specialize in any of the phases of engineering listed above — see the Sperry representative when he visits your school — or write now to J. W. Dwyer, Sperry Gyroscope Company, Section 185.

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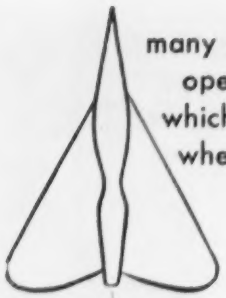
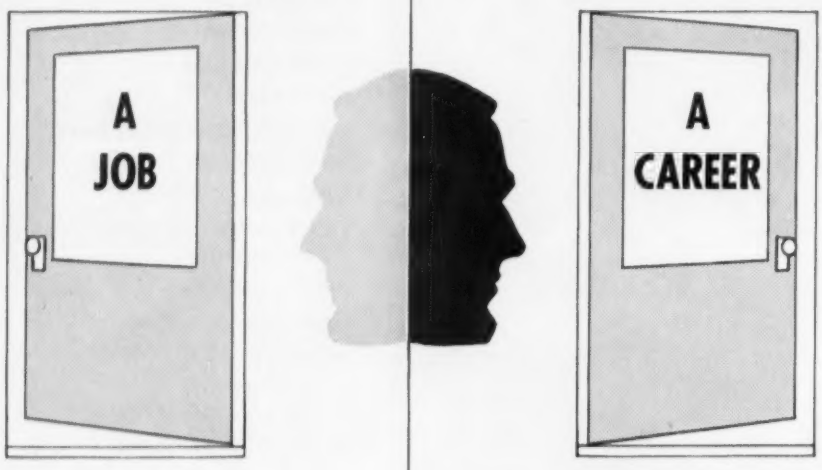


many doors will be opened to you... which will you enter when you become an

engineer



OPPORTUNITY KNOCKS for engineering careers at this magnificent new jet aircraft equipment plant

Make the *right* choice when you begin to invest your hard-won skill and knowledge in engineering. Hamilton Standard offers a plant where initiative and responsibility are encouraged . . . where young men are in top management posts . . . an engineering staff which has been continuously expanding for 35 years . . . a plant which has been judged one of the top 10 in the nation. You don't just fill a position at H-S . . . you commence a career! Some of Hamilton's present projects include jet fuel controls, jet turbine starters, hydraulic pumps, air cycle and vapor refrigeration systems, controls and accessories for nuclear engines, propellers for turbine and piston engines.

GRADUATE PROGRAM . . . while at Hamilton Standard you will be encouraged to take advantage of the company's liberal tuition assistance plan and to pursue postgraduate studies at nearby Hartford Graduate Center of Rensselaer Polytechnic Institute.

HAMILTON STANDARD

Send for "YOU AND YOUR FUTURE"

. . . a colorful brochure picturing and describing all of the activities and opportunities at H-S . . . plus information on the graduate engineering program. Write Mr. T. K. Bye, (111) Bradley Field Road, Windsor Locks, Connecticut.

HAMILTON STANDARD A DIVISION OF UNITED AIRCRAFT CORPORATION

GRADUATING ENGINEERING PHYSICISTS

—Photo Science

1. Stotz, Robert H.
2. Gilinsky, Victor
3. Jacobson, Charles F.
   Siegel, Prof. Benjamin M.
4. Thomson, Richard M.
5. Usiskin, Clive M.
6. Smith, Gordon L.
7. Farley, Donald T., Jr.
8. Janes, Hugh P., Jr.
9. Comstock, Craig
10. Rosenbaum, Richard
11. Iglehart, Donald L.
12. Erickson, John C., Jr.
13. London, Howard S.
14. Ho, Hau-wong
15. DeBell, David A.
16. Sklar, Howard
17. Harris, Stephen M.

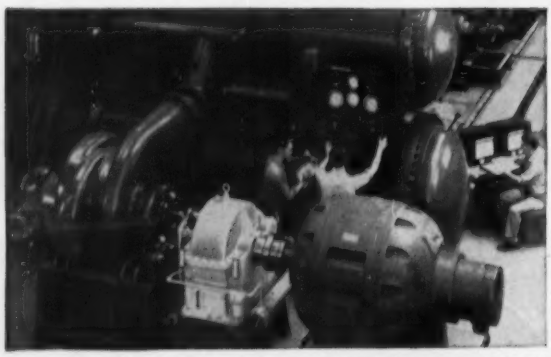
GRADUATING CHEMICAL ENGINEERS

—Photo Science

1. Bunting, R. L., Jr.
2. Von Berg, Prof. R. L.
3. Smith, Prof. J. C.
4. Finn, Prof. R. K.
5. Rhodes, Prof. E. H.
6. Mason, Prof. C. W.
7. Burton, Prof. M. S.
8. Smith, Prof. G. V.
9. Thorpe, Prof. R. G.
10. Harriott, Prof. P.
11. Sicherman, J. I.
12. Shertzer, C. R.
13. Tomfohrde, H. G.
14. Urban, R. J.
15. Harris, J. R.
16. Buckenmaier, E. T.
17. Hohenberg, P. M.
18. Pollak, E. B.
19. Sylla, J. R.
20. Hessel, M. M.
21. Rodriquez, G.
22. Chester, C. V.
23. Mayer, B.
24. Ord, R., Jr.
25. Mallin, J.
26. Trostel, A. O., III.
27. Johnson, D. B.
28. Burton, R. S.
29. Brown, G., Jr.
30. Hittner, L. B.
31. Davis, G. T.
32. Bradley, P. G.
33. Grosso, P.
34. Baldeschweiler, J. D.
35. Love, R. J.
36. Bernard, D. A.
37. Rios, A. R.
38. Reagan, P. H., Jr.
39. Brown, W. R.
40. Pozos, M. A. G.

"POWER OFF!" Test operations are directed from this central control room, where special measuring instruments greatly speed up the collection of pump performance data. That's one way Worthington products are made more reliable by using . . .

. . . the world's most versatile hydraulic proving ground



COMPREHENSIVE TESTS are run on a Worthington centrifugal refrigeration unit (lower left) now in service as one of the Arabian American Oil Company's central air conditioning units in Dhahran, Saudi Arabia.

When you make pumping equipment that has to stand up and deliver year after year anywhere in the world, you've got to be sure it will perform as specified.

That's why we built one of the world's largest hydraulic test stands at our plant in Harrison, New Jersey. Here, over a half-acre "lake," we can check the performance of anything from a fractional horsepower unit to pumps handling over 100,000 gallons a minute. When you realize there are thousands of sizes and types of centrifugal pumps alone, you get an idea of the versatility we had to build into our proving-ground.

Naturally, our new test equipment is a big help to our research engineers, as well as our customers. Now they get performance data on products quickly and accurately. Using it, we can save months, even years, in developing new Worthington fluid and air-handling devices — equipment for which this company has been famous for over a century. For the complete story of how you can fit into the Worthington picture, write F. F. Thompson, Mgr., Personnel & Training, Worthington Corporation, Harrison, N. J.

4.25A

See the Worthington representative when he visits your campus

See the Worthington Corporation exhibit in New York City. A lively, informative display of product developments for industry, business and the home. Park Avenue and 40th Street.

WORTHINGTON

When you're thinking of a good job—think high—think Worthington

AIR CONDITIONING AND REFRIGERATION • COMPRESSORS • CONSTRUCTION EQUIPMENT • ENGINES • DEAERATORS • INDUSTRIAL MIXERS
LIQUID METERS • MECHANICAL POWER TRANSMISSION • PUMPS • STEAM CONDENSERS • STEAM-JET EJECTORS • STEAM TURBINES • WELDING POSITIONERS

AIR CONDITIONING:

A Career for Engineers with Management Potential

- The field is already big, growing fast . . .
- York is a leader in the field . . .
- Every York installation is engineered . . .
- That's why York looks for engineers with management potential, trains them well for responsible positions.

Air Conditioning today is more than accepted; it's expected and such burgeoning industries as frozen foods are making heavy demands for refrigeration. York clients include banks, hotels, huge office buildings, industrial plants, food processors, and government installations.

York systems are engineered to fit the particular requirements of each customer. This is important to York, because it is one of the factors contributing to York's reputation as a producer of *quality* air conditioning and refrigeration. It is important to the graduate engineer, because it indicates York's dependence upon the *engineer*. York industrial systems are not sold across the counter: they are sold by *engineers* who contribute their skills to the specification and installation of the system, each step of the way. And the jobs vary: today's job might be a large office building; tomorrow's a bank, or a store or a huge factory, or even an environmental test hanger for the Air Force.

York management is largely drawn from its engineering staff. Today, of the *25* top engineering executives at York, *19* came up through the YORK College Graduate Training Program. Being engineers, they know the problems and aspirations of young engineers, and they know how to help them get ahead.

The YORK College Graduate Training Program, alone in the industry, provides a personalized and tailored training content beamed to the specific placement chosen by the young Engineering graduate. It is comprised of integrated classroom and on-the-job training assignments, which considers the many aspects of personal development. At YORK, the title "Student Engineer" is a mark of distinction. It is the proven pathway to personal success in a highly technical industry.

To learn more about the Air Conditioning and Refrigerating industry, York Corporation and its highly effective College Graduate Training Program — see the Placement Director of your college or university to get a copy of the booklet "LIFE-TIME CAREERS WITH YORK". For specific information as to how you and YORK might fit together for the years ahead, write: Training and Education Department, York Corporation, York, Pennsylvania.

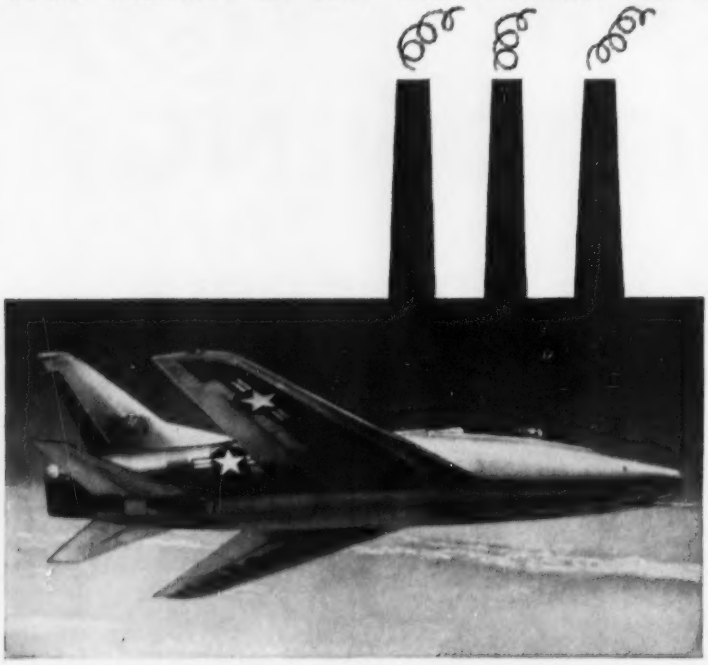
York refrigeration air conditioning

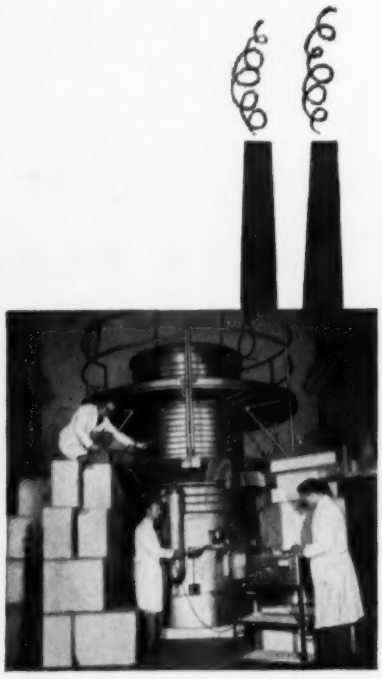
the quality name in air conditioning

HEADQUARTERS FOR
MECHANICAL COOLING SINCE 1885

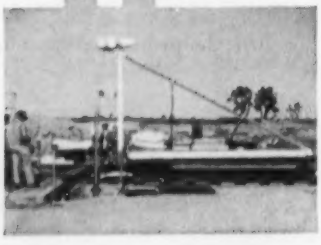
YORK
CORPORATION

NORTH AMERICAN HAS BUILT MORE AIRPLANES THAN ANY OTHER COMPANY IN THE WORLD





DIVERSITY CREATES OPPORTUNITY



Although best known for design and production of world-famous aircraft like the Korea-famed F-86 *Sabre* Jet and the new, record-smashing F-100 *Super Sabre* . . . North American Aviation also offers engineers excellent opportunities in other technical fields.

North American needs engineers with imagination to help design and build the aircraft of the future. Other fascinating careers are created daily in its rapidly developing guided missile, jet, propulsion systems, electronic and atomic energy programs.

When you are ready to enter the engineering profession, consider the well-paid opportunities at North American. Meanwhile, write for information on your future in the aircraft industry.

Contact: **Your College placement office or write:**

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Los Angeles

12214 South
Lakewood Blvd.,
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North American
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NEW DEPARTURES OF TOMORROW

TOMORROW: Pick your favorite foods! Then this imaginary SUPER CHEF assembles your choice from a vast freezer storage, cooks it to perfection by infra-red ray and serves it by conveyor in a *matter of seconds!*

Set the table . . . then set the dial! Future meals could be as easy as that with this miracle meal-getter. And, maybe tomorrow it will be a reality.

When it is, New Departure will play an important part, just as it does in so many of today's work-savers. For example, you'll find New Departure ball bearings in almost every major appliance . . . and for good reason. They keep moving parts functioning smoothly, while requiring virtually no maintenance. They support loads from any direction . . . keep parts always in perfect alignment.

TODAY: The operation of many of today's conveniences relies on New Departures. Specially designed, low-cost New Departure ball bearings in the hinges of this heavy refrigerator door make it swing open at the lightest touch.

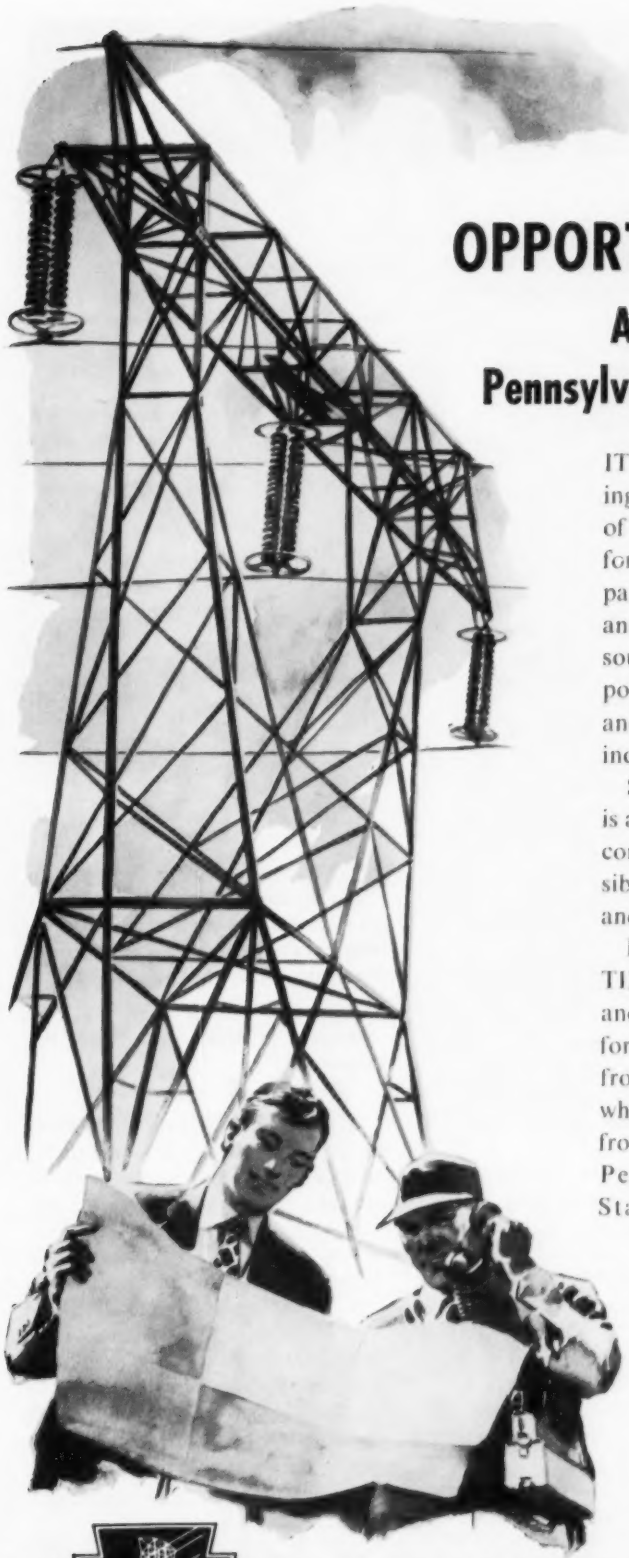
NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONNECTICUT

GM GENERAL MOTORS

NEW DEPARTURE

BALL BEARINGS

NOTHING ROLLS LIKE A BALL



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Satisfying America's need for electric power is a mighty big job . . . and one that is growing continually. You can grow with it in a responsible position limited only by your initiative and ability.

Plan for a future FULL OF OPPORTUNITIES in a sound industry paying good salaries and in a State that can provide all the facilities for a full and enjoyable life. Get the facts from the Electric Utility Company in the area where you would like to work and live, from your Placement Counselor, or write—Pennsylvania Electric Association, State Street Building, Harrisburg, Pa.

Pennsylvania Electric Association

25 INDEPENDENT COMPANIES PROVIDING POWER FOR PENNSYLVANIA'S PROGRESS

STRESS *and* STRAIN...

A college student is one who enters his alma mater dressed in green and emerges as a senior dressed black. The intermediate process of decay is known as college education.

* * *

Thermometers aren't the only things that are graduated and have many degrees without having any brains.

* * *

Applicant: "I'm Gladys Zell."
Personnel Manager: "I'm happy myself. Have a seat."

* * *

He: "Whisper those three little words that will make me walk on air."
She: "Go hang yourself."

* * *

A sexton, cleaning up the pulpit after Sunday service, took a peek at the preacher's manuscript. Along the left margin were instructions such as, "Pause here," "Wipe brow here," "Use angry gesture," "Look upward."

Near the end was a long paragraph of texts, opposite which the preacher had marked in large capital letters 'ARGUMENT WEAK HERE. YELL LIKE HELL!"

* * *

Irate golfer: "You must be the world's worst caddie."
Caddie: "Hardly. That would be too much of a coincidence."

* * *

Don't be afraid to use your brain, it's the little things that count.

* * *

The E.E.'s Lament

Through the smoke and ozone fumes
The student slowly rises,
His hair is singed, his face is black,
His partner he despises.
He shakes his head and says to him
With words so softly spoken,
"The last thing that you said to me
'I'm sure the switch is open'."

* * *

A chaperone is a force acting on a couple to maintain it in a state of equilibrium.

After watching a drunk try to unlock the door to his house without success, a policeman went over and asked if he might handle the key for him.

"No thanksh," the inebriated chap answered. "I gotta pretty good hold on thish key. You try and grab the housh."

* * *

"So your husband is one of the big guns of industry."
"Yes, he's been fired seven times."

* * *

I serve one purpose in this school
On which no man can frown.
I quietly sit in every class,
And keep the average down.

* * *

Prof.: "Why don't you answer when I call your name?"
Student: "I nodded my head."
Prof.: "You don't expect me to hear the rattle all the way up here do you?"

* * *

ROTC Student: "Well, one piece fits me."
Supply Sgt.: "Yeah? Which one?"
ROTC Student: "The necktie."

* * *

Funeral director to aged mourner: "How old are you??"
"I'm 97; be 98 next month."
"Hardly worth going home, is it?"

* * *

The legend is told that in the days of ancient Rome an officer, called away to the wars, locked his beautiful young wife in armor and gave the key to his best friend, with the admonition: "If I don't return in six months, use this key. To you, my dear friend, I entrust it."

Ten miles away from home, he saw a cloud of dust approaching and waited.

His friend, on horseback, galloped up, saying: "You gave me the wrong key."

* * *

ENGINEER'S WHISKEY TEST

Connect 20,000 volts across a pint. If the current jumps it, the product is poor.

If the current causes the precipitation of lye, tin, arsenic, iron slag, and alum, the whiskey is fair.

If the liquor chases the current back to the generator, you've got good whiskey.

* * *

According to a story going around Western Europe, one Prague resident refused to join the outcry against a new Stalin statue in the city's public square.

"Why not a statue?" he said, "It'll give us shade in the summer, shelter in the winter and an opportunity for the birds to speak for us all."

* * *

"Hey, Dad, I'm home from school again."
"What the devil did you do this time?"
"I graduated."

* * *

Vocational adviser to youth: "Your vocational aptitude test indicates that your best opportunities lie in a field where your father holds an influential position."

* * *

Advice to professors: "Vary the monotony."

* * *

The little boy wanted $100 so badly he decided to pray for it. He prayed for several weeks, with no results; so he wrote a letter to God. The post office finally forwarded the letter to the White House. The President chuckled and ordered $5 sent to the boy. The lad delighted that his prayers had been answered, in part at least, wrote a thank-you to God, but added this P. S.: "I notice you routed letter through Washington and as usual those bureaucrats deducted 95%."

* * *

Teacher (in English III): Spell straight.
Engineer: S-T-R-A-I-G-H-T.
Teacher: Correct. Now what does it mean?
Engineer: Without ginger ale.

In the Arma Visual Computer, a single control selects the desired chart from as many as 700 photo slides. Each slide contains punched code holes which automatically tune in the corresponding Omni Bearing Distance station. The image of the plane is governed by a combination of the radio signals and the plane's gyro instruments.

Photography teams with electronics and adds new certainty to flight

Now a visual computer pictures a plane's precise position and heading on projected photos of aeronautical maps.

Arma Division, American Bosch Arma Corp., working with the Air Navigation Development Board and C.A.A., has developed a valuable new aid in air navigation using photography.

With it the pilot, high above the weather, flicks a switch and before him appears a map of the area he's over. On the screen a tiny shadow of a plane moves and shows exactly where he is, where he's heading and whether he's on course.

This spells added certainty. Even more! It can mean savings in time and money, too. For the flight can proceed by plan rather than by dog-legs on the beams.

So again we see photography at work helping to improve operations—doing it for commercial aviation just as it does for manufacturing and distribution.

Photography works in many ways for all kinds of business, large and small. It is saving time, saving money, bettering methods.

This is why graduates in the physical sciences and in engineering find photography an important tool in their new occupations. Its expanding use has also created many challenging opportunities at Kodak, especially in the development of large-scale chemical processes and the design of complex precision mechanical-electronic equipment. If you are interested in these opportunities, write to Business and Technical Personnel Department, Eastman Kodak Company, Rochester 4, N. Y.

Eastman Kodak Company, Rochester 4, N. Y.

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As a G-E representative in one of the Company's 147 Apparatus Sales Offices in key cities, you work with customers to determine what design, new development or system will best serve their needs. The program offers—in addition to exciting district work—career opportunities in the Company's headquarters marketing and sales operations. 956-7

*ILLUSTRATION: *Sales Engineer and customers discuss turbine rotor construction. Glasses are factory safety measure.*

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